

# Handbook for the development of renewable energy in Victoria

Guidance to avoid, minimise, mitigate and compensate for impacts on threatened bird and bat species

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**ISBN 978-1-76176-287-1 (pdf/online/MS word)**

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# 1. Introduction

Climate change is a critical issue for Victoria and the world. The intensity and frequency of Victoria's extreme weather is increasing, resulting in more frequent and intense bushfires and storm events and presenting significant challenges for safeguarding Victoria's unique biodiversity into the future. The need to reduce Victoria's greenhouse gas emissions is urgent if the state is to play its part in addressing climate change.

Renewable energy will play the central role in achieving the Victorian Government's 2045 net-zero emissions goal. With over two-thirds of Victoria's emissions coming from the energy sector, renewable energy provides the largest opportunity to cut the state's emissions. The Government has set ambitious targets for using renewable energy, including 65 per cent of the state's energy to come from renewable sources by 2030 and 95 per cent by 2035. To meet these targets, an exponential increase in the scale and pace of new renewable energy projects and associated infrastructure is required over the next decade. Wind and solar energy facilities will lead the transition to clean renewable energy in Victoria.

The large-scale renewable energy projects needed will also impact biodiversity. Robust environmental assessments are required to identify impacts and assess options for their avoidance, mitigation or management – particularly for species that are assessed as being most at risk from renewable energy development.

This Handbook is intended to support existing planning and environmental assessment requirements under the *Planning and Environment Act 1987* and the *Environment Effects Act 1978*, and to provide more detailed guidance on how to best manage biodiversity impacts while facilitating renewable energy development.



## 2. Purpose of this Handbook

The purpose of this Handbook is to provide guidance to project proponents and environmental and planning assessors and decision-makers about how to manage impacts on Victorian threatened bird and bat species from renewable energy development.

The Handbook, supported by decision-support tools, outlines the policies and priorities the Government considers necessary to achieve a balance between facilitating renewable energy development and protecting threatened bird and bat species. The Handbook:

- clarifies the Government's expectations in relation to managing impacts on threatened bird and bat species
- describes the methods that can be used by project proponents to manage the impacts on threatened bird and bat species of their projects using the mitigation hierarchy
- incorporates specific guidance to manage impacts on certain threatened bird and bat species from onshore wind energy facilities.

It is intended that the Handbook can be applied at various stages of project site selection, scoping and design, environmental assessment and planning approval.

This Handbook is intended as a resource for:

- proponents considering developing onshore renewable energy facilities in Victoria
- responsible authorities and stakeholders who provide advice and consider the appropriateness of a renewable energy proposal in any given location.



## 3. Scope of this Handbook

The Handbook applies to **onshore renewable energy facilities** that are likely to have an impact on threatened bird and bat species. It outlines a **risk-based approach for applying the mitigation hierarchy** to manage these impacts through existing environmental assessment and planning approval processes.

Renewable energy facilities can result in local and cumulative impacts on threatened bird and bat species due to the scale of the development, its location, the type of technology used and the use and operation of infrastructure. In many cases, there is uncertainty about the interaction of mobile or migratory species with such projects and about the nature and extent of impact on species populations alongside other threats and impacts.

The Handbook will be progressively reviewed and updated over time to improve guidance for managing potential impacts on threatened bird and bat species of all types of renewable energy developments and to incorporate the best available information.

### 3.1 What species does the Handbook apply to?

#### Bird and bat species listed under the Flora and Fauna Guarantee Act 1988

The *Flora and Fauna Guarantee Act 1988* (FFG Act) provides for the listing of taxa, communities of flora and fauna and potentially threatening processes. The Threatened List contains Victoria's native flora, fauna and ecological communities recognised as being at risk of extinction. As outlined further below in Section 4, assessment of impacts on species listed under the FFG Act is required as part of planning permit applications and environmental impact assessments.

This Handbook specifically applies to managing impacts of renewable energy facilities on bird and bat species included on the Threatened List.

#### Species of Concern

The Department of Energy, Environment and Climate Action (DEECA) has identified the threatened bird and bat species most at risk from the operation of onshore wind energy facilities in Victoria – the Species of Concern List<sup>1</sup> [see **Appendix 1**]. This is to assist both proponents and decision-makers in applying requirements in the Handbook by focusing on those species which, because of their status, location or behaviour, are at particular risk from the development of onshore wind energy facilities. Where a proposed onshore wind energy facility may impact a Species of Concern,

priority should be given to addressing the risks to these species.

DEECA has developed specific guidance based on the best available information to support identification, assessment and management of the impacts of onshore wind energy facilities on the Victorian Brolga [see **Appendix 2**] and bat species [see **Appendix 3**].

DEECA will continue to monitor the impacts of renewable energy development on threatened bird and bat species and will update the Species of Concern List as appropriate. Consultation will be undertaken on any proposed changes before they are made.

#### Species of cultural significance for Traditional Owners and First Nations people

The proponent of any proposed renewable energy facility should engage with relevant representatives of the Traditional Owner Corporation or First Nations group as part of their siting, design and planning process to determine if the proposal is likely to impact on a species with cultural significance to First Nations people.

The Government encourages proponents to engage early and meaningfully and work proactively and in partnership with traditional custodians of the land on which they intend to develop and to support them to self-determine how they wish to participate in the development of renewable energy facilities on Country.

Where impacts on culturally significant species are likely, Traditional Owner knowledge can support identifying and applying appropriate measures to manage impacts and for monitoring, reporting and adaptive management. Proponents are encouraged to work with the relevant Traditional Owner Corporation or First Nations group so that cultural values can be consistently embedded within project planning.

<sup>1</sup> In the first instance, Species of Concern have been identified for onshore wind energy facilities. This list includes species listed under both the FFG Act and the *Environment Protection and Biodiversity Conservation Act 1999*. This list will be updated over time to apply to all types of renewable energy development.



## 4. Application of this Handbook

The Handbook is intended to be used to support environment and planning assessment and approval processes for proposed renewable energy facilities under the current regulatory framework. It does not change any of the existing legislative or policy requirements for assessment or approval. Rather, it provides guidance on actions that can be taken to meet such requirements.

### 4.1 Planning Permit Requirements

A renewable energy facility requires a planning permit under the *Planning and Environment Act 1987* (P&E Act) and local planning schemes. A project proponent must consider all relevant sections of the applicable planning scheme when applying for a planning permit for a renewable energy facility. In relation to biodiversity, this includes consideration of *Clause 12.01 Protection of biodiversity*, as well as application requirements for renewable energy facilities set out in *Clause 52.32: Wind Energy Facility*, *Clause 53.13: Renewable Energy Facility (Other Than Wind Energy Facility)* or *Clause 53.22: Significant Economic Development*. The table below outlines where this Handbook might be relevant to use to meet requirements of these Clauses.

**Table 1: Planning Application Requirements**

Planning scheme clause	What requirement can the Handbook support?
<p><i>Clause 52.32: Wind Energy Facility</i></p> <p>Before deciding an application under this Clause, the responsible authority must consider the impact of the facility on the natural environment and natural systems.</p> <p>Requirements outlined in the <i>Planning Guidelines for Development of Wind Energy Facilities</i> (Department of Environment, Land, Water and Planning, November 2021) must also be considered. These Guidelines state that "<i>Wind energy facilities should not lead to unacceptable impacts on critical environmental, cultural or landscape values</i>"<sup>2</sup>.</p>	<p>This Handbook can be used to support preparation and assessment of planning application requirements in Clause 52.32, in particular:</p> <ul style="list-style-type: none"> <li>• When preparing a site and context analysis that accurately describes the site and surrounding area. This analysis must outline the species of flora and fauna listed under the FFG Act and the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act) for the site, as well as information on the surrounding area that relates to sites of listed species, parks and reserves and other conservation areas (amongst other matters).</li> <li>• When preparing the design response for a proposal, which must address the impact of the proposal on any species (including birds and bats) listed under the FFG Act or the EPBC Act. It must also include an environmental management plan outlining any rehabilitation and monitoring requirements.</li> <li>• To address matters that must be considered under the <i>Planning Guidelines for Development of Wind Energy Facilities</i> to determine suitable locations for new wind energy development. Under these Guidelines, assessment of the proposed development must carefully examine any risk to flora and fauna species, impacts should be minimised through siting and design measures at the project planning stage and project design and adaptive management measures should be applied where necessary.</li> </ul>

<sup>2</sup> [https://www.planning.vic.gov.au/\\_data/assets/pdf\\_file/0021/570630/Development-of-wind-energy-facilities.pdf](https://www.planning.vic.gov.au/_data/assets/pdf_file/0021/570630/Development-of-wind-energy-facilities.pdf); pg 7



Planning scheme clause	What requirement can the Handbook support?
<p><i>Clause 53.13: Renewable Energy Facility (Other Than Wind Energy Facility)</i></p> <p>Before deciding an application under this Clause, the responsible authority must consider the impact of the proposal on the natural environment and natural systems.</p> <p>Requirements outlined in the <i>Solar Energy Facilities Design and Development Guideline</i> (Department of Environment, Land, Water and Planning, October 2022)<sup>3</sup> must also be considered.</p>	<p>This Handbook can be used to support preparation and assessment of planning application requirements in Clause 53.13, in particular:</p> <ul style="list-style-type: none"> <li>When preparing a design response that includes an assessment of the impact of the proposal on any species listed under the FFG Act or the EPBC Act and an environmental management plan including, a construction management plan, any rehabilitation and monitoring.</li> <li>To address matters that must be considered under the <i>Solar Energy Facilities Design and Development Guideline</i>, including that a solar energy facility should not lead to the loss of vegetation, habitat or species of environmental importance. If losses cannot be avoided, they should be minimised and can be offset. Impacts on flora and fauna species and habitats by a solar energy facility and its associated infrastructure can be avoided or minimised by addressing siting and design considerations at the site selection and project planning stages.</li> </ul>
<p><i>Clause 53.22: Significant Economic Development</i></p>	<p>This Handbook can be used to support preparation and assessment of planning application requirements in Clause 53.22. Under this Clause, proposals are assessed through the Development Facilitation Program (DFP), which is an accelerated assessment pathway for eligible projects to inject investment into the Victorian economy, keep people in jobs and create homes for people. This includes a renewable energy facility with an installed capacity of 1 megawatt or greater.</p> <p>All applications are assessed on planning merit, which includes the following:</p> <ul style="list-style-type: none"> <li>alignment with the P&amp;E Act (including the objectives of planning in Victoria)</li> <li>alignment with state and local provisions of the planning scheme</li> <li>consideration of the local context, including potential amenity and environmental impacts.</li> </ul>
<p><i>Clause 12.01: Biodiversity</i></p>	<p>Clause 12.01 is part of the Planning Policy Framework and must be considered, where relevant, when assessing a planning permit application for renewable energy facilities. Clause 12.01 outlines the objective to protect and enhance Victoria's biodiversity and relevant strategies, guidelines and policy documents that must be considered in seeking to achieve that objective. This Handbook can be used to support application of the strategies outlined in Clause 12.01 and in assessing whether the biodiversity objective is met.</p> <p>Clause 12.01-2S outlines the objective in relation to native vegetation management. Renewable energy facilities that include the removal, destruction or lopping of native vegetation may require planning approval under Clause 52.17 of local planning schemes and in accordance with the <i>Guidelines for the removal, destruction or lopping of native vegetation</i> (Department of Environment, Land, Water and Planning, 2017). This Handbook does not change or apply to these requirements. It applies in parallel to provide guidance on how to manage impacts on threatened bird and bat species.</p>

<sup>3</sup> [https://www.planning.vic.gov.au/\\_data/assets/pdf\\_file/0037/659917/Solar-Energy-Facilities-Design-and-Development-Guideline.pdf](https://www.planning.vic.gov.au/_data/assets/pdf_file/0037/659917/Solar-Energy-Facilities-Design-and-Development-Guideline.pdf)

## 4.2 Environmental Assessment Requirements

The *Environment Effects Act 1978* (EE Act) provides for environmental impact assessment of proposed project works capable of having a significant effect on the environment. Proponents may be required to complete and submit to the Minister for Planning an environment effects statement (EES) or Environment Report. Assessments analyse the potential effects of projects on the environment and the means of avoiding, minimising, managing, rehabilitating and offsetting adverse effects.

*Ministerial guidelines for assessment of environment effects* (8th edition) accompany the EE Act to guide and clarify the assessment processes. These guidelines outline the criteria for referral to determine if a project could reasonably be expected to have the potential for a significant effect on the environment and the processes and requirements for the referral and assessment of projects through an EES or Environment Report. Assessments are prepared in the context of a systems approach, proportionality to risk and ecologically sustainable development. A risk-based approach should be adopted, whereby matters that pose relatively high risk of significant adverse effects should be assessed via suitably intensive methods to guide accurate assessment of risks and the design of strategies to manage those risks and matters that pose lower risk may be subject to simpler or less comprehensive methods of assessment.

The Minister for Planning determines whether the project will or will not have an acceptable level of environment effects or if it requires modifications/ further investigations to achieve acceptable outcomes. This assessment then informs planning approvals.

This Handbook can be used to support the processes and requirements under the EE Act and EES Ministerial guidelines, including identification of project risks and consideration of significance of those risks, whether referral criteria related to impacts on native fauna species (specifically threatened bird and bat species) are met, preparation and assessment of a referral request, scoping requirements for assessment, assessment methods and preparation and assessment of strategies and measures to manage risks to species.

## 4.3 Other environmental approvals

Depending on the circumstances, a proposed renewable energy project may require approval under other environmental legislation such as the FFG Act or the *Wildlife Act 1975*. This Handbook does not change or apply to those requirements.

Renewable energy facilities may also be required to receive separate approval under the Commonwealth EPBC Act. The Commonwealth Government has published its own guidance on how to meet these requirements which is available from the Department of Climate Change, Energy, the Environment and Water website: <https://www.dcceew.gov.au/environment/epbc/advice/renewable-energy-projects>.



#### 4.4 The role of the Department of Transport and Planning (DTP)

DTP works together with local councils in Victoria to implement the objectives of planning.

The Minister for Planning is the responsible authority for new planning permit applications for energy generation facilities that are 1 megawatt or greater. These projects are also treated as significant economic developments (Clause 53.22 of planning schemes), making them eligible for the Development Facilitation Program (DFP).

The DFP offers a service for industry to help map out planning approval pathways and resolve planning issues as applications are evolving. Proponents can [request a pre-application meeting online](#) or email [energy.assessment@transport.vic.gov.au](mailto:energy.assessment@transport.vic.gov.au) to meet with DFP planners and gain advice on how to best advance their renewable energy project.

DTP also administers the environment assessment process under the EE Act and EES Ministerial guidelines and supports the Minister for Planning to make an assessment under the EE Act.

#### 4.5 The role of DEECA

DEECA provides place and topic-based information and service delivery across programs for which the Secretary of DEECA and the Minister for Environment have responsibility or interest, including threatened species and communities, native vegetation and Crown land management.

DEECA supports responsible authorities in their decision-making role in environmental assessment and planning approval processes by reviewing and providing advice on specific matters addressed in applications. Proponents and the responsible authority typically seek DEECA's advice relating to potential impacts of renewable energy facilities on species listed under the FFG Act to support the planning and environmental assessment and approvals processes and to give effect to planning permit conditions that may require consultation with DEECA.

DEECA plays a key role in supporting delivery of the Victorian Government's ambitious economic development agenda by providing advice and information to assist proponents and decision-makers identify and apply the most appropriate options for preserving Victoria's unique biodiversity while facilitating the energy transition..

#### 4.6 Commencement and transitional arrangements

This Handbook will commence on the day it is published on DEECA's website. However, a proponent will not be expected to apply the Handbook to their project if:

- a. prior to commencement of the Handbook:
  - the project has been referred to the Minister for Planning for assessment under the EE Act
  - an assessment under the EE Act has commenced for the project
  - a planning permit application has been lodged for the project; or
- b. any of the above will occur within 12 months from the date of commencement of the Handbook.

Despite the above transitional arrangements, a proponent may decide to apply this Handbook, including species-specific guidance, to their project from the date of commencement. This must be agreed with DTP, in consultation with DEECA, and clearly articulated in any documents used to assess the proposed project.

## 5. Principles to guide application of the Handbook

This Handbook outlines guidance for managing the impacts on threatened bird and bat species from renewable energy facilities. It does not provide prescriptive answers for every development or situation. Instead, the application of this Handbook will be guided by a set of principles that should be used by proponents and decision-makers when seeking to apply this guidance:

**1. Transitioning to renewable energy sources is crucial for reducing greenhouse gas emissions and mitigating climate change, thereby protecting biodiversity and supporting its long-term security.**

Renewable energy is a key contributor to Victoria's energy transition, achieving net zero emissions by 2045 and minimising the impacts of climate change on humans and the environment. An exponential increase in the scale and pace of new renewable energy projects is required to meet the Government's ambitious renewable energy targets of 65 per cent by 2030 and 95 per cent by 2035.

**2. A balanced approach to assessing the potential benefits and impacts of renewable energy facilities is required.**

Overall, renewable energy projects – by cutting greenhouse gas emissions and slowing climate change – help mitigate a key threat to biodiversity. But in some locations, renewable energy facilities may pose a risk to threatened species that must be managed appropriately. These issues need to be balanced through the environmental and planning assessment and approval processes.

**3. Renewable energy development should be encouraged in areas with lower impact on biodiversity.**

Siting renewable energy facilities requires careful planning. Locating projects in areas of lower biodiversity value will help to reduce costs and avoid project delays and impacts to the very same species and natural areas the government is trying to protect from climate change. Assessment of proposed renewable energy facilities will be influenced by the level of biodiversity risk presented by the proposal.

**4. Biodiversity impacts from renewable energy developments should be avoided, minimised and mitigated to the maximum extent practicable.**

The mitigation hierarchy is a tool that is used to limit the amount of damage development and other activities will have on the environment. Each step in the hierarchy must be followed in order and to the maximum extent practicable before moving on to the next. Any avoid, minimise or mitigation measures to be incorporated into renewable energy facilities to manage impacts on threatened bird and bat species should be based on the best available information, be explicitly linked to the identified impacts and be reasonable and feasible in the context of the proposed development.

**5. Only after the avoid, minimise and mitigate steps of the mitigation hierarchy have been applied to the maximum extent practicable can compensatory measures be considered to manage residual impacts.**

Offsetting / compensation is the final step in the mitigation hierarchy and should only be applied once impacts have been avoided, minimised and mitigated to the maximum extent practicable. In this Handbook, compensatory measures can be used to address residual impacts on threatened bird and bat species.

**6. Robust, transparent and accessible monitoring, reporting and adaptive management requirements should be required for renewable energy facilities.**

Monitoring, reporting and adaptive management requirements will be determined for each approved renewable energy facility, and applied through planning permit conditions. Monitoring data collected must be suitable for robustly informing state and regional mortality information and reports should be made publicly available (subject to any necessary redactions for confidentiality or privacy reasons or related to sensitive ecological information).



## 6. Using a risk-based approach to identify, assess and manage impacts on threatened bird and bat species

This Handbook recommends a risk-based approach is used to identify, assess and manage impacts on threatened bird and bat species from renewable energy facilities. This is consistent with the EES Ministerial Guidelines.

Adopting a risk-based approach enables evaluation of the interactions between biodiversity values, impacts and risks to these values and suitable management actions for protecting the values. This Handbook provides guidance on how this can be done in a consistent, clear and structured way.

In accordance with the Victoria Planning Provisions (VPP) and the EES Ministerial Guidelines, robust approaches to identifying and assessing potential impacts on threatened bird and bat species will inform selection of appropriate strategies and measures under the mitigation hierarchy to achieve an acceptable level of impact for the proposed renewable energy facility.

### 6.1 Identifying risks to threatened bird and bat species as part of site and context analysis

Early identification of potential characteristics of the proposed development site and surrounding area that may indicate risks to threatened bird and bat species from a renewable energy facility can help proponents choose or design sites to minimise impacts. Identifying and assessing risks as part of the site and context analysis could also help inform decisions about the potential significance of impacts and therefore approval pathways (e.g. whether an EES or Environment Report is required), assessment of impacts and the design response, and strategies and measures required to manage those impacts using the mitigation hierarchy.

Some areas of Victoria are more sensitive to the impacts of development than others. The cost, availability, effectiveness or viability of measures to avoid, minimise, mitigate or compensate for impacts may vary depending on whether a site is located in an area of low or high biodiversity value. Early site and context analysis should identify important biodiversity features and potential project impacts at suitable scales and should consider seasonality. All elements of project infrastructure and impact types (direct, indirect, cumulative) should also be considered.

The criteria outlined below have been developed to support identification of risks for threatened bird and bat species from potential development sites. Applying the criteria to a proposed site can help to identify the location and extent of biodiversity values relevant to threatened bird and bat species so that this can be considered alongside other critical project considerations – such as energy resource, access to transmission infrastructure, competing land uses and proximity to residential areas – early in the planning and design process. The risks presented by the proposed site and surrounding context are likely to indicate what the potential impacts would be for threatened bird and bat species during construction and operation of the renewable energy facility [see **section 6.2**].

### Criteria 1 – Does the project site have high biodiversity values?

DEECA has developed the Habitat Value Map to support the assessment of biodiversity risk across Victoria. This map is a spatial dataset developed and published by DEECA that synthesises the best techniques and data available to create a ranked map of biodiversity values across the state. The map combines information on thousands of species and their habitats to show the relative biodiversity values in Victoria. The dataset has been built utilising established techniques from the scientific field of Systematic Conservation Planning.

Biodiversity values mapping provides decision-makers with an objective and comprehensive view of the relative biodiversity importance of all parts of Victoria, to help prioritise areas for protection or avoid areas of high biodiversity value in development footprints. The values mapping does not highlight areas that are “no-go” zones for development. Instead, it can be used to consider the relative value of biodiversity to help site and design infrastructure that minimises impacts.

#### Terrestrial – Habitat Value Map

The Habitat Value Map identifies those areas of greater or lesser biodiversity sensitivity by dividing the state into 75 by 75 metre grid squares (pixels), assigning a numerical value to each square that reflects the relative biodiversity value of the area contained within that square. The Habitat Value Map has been incorporated into DEECA's NatureKit platform: [https://www.environment.vic.gov.au/biodiversity/habitat\\_value](https://www.environment.vic.gov.au/biodiversity/habitat_value).

#### Use of mapping tools to assist in identifying risks

Developments that are proposed to take place in areas with high biodiversity values will be considered as presenting a higher risk to biodiversity than those proposed in areas of lower biodiversity value. These mapping tools can be used as a starting point to identify overall biodiversity value and risk and to inform what might be needed for site specific analysis to determine potential risks to threatened bird and bat species. They are not a real-time view of biodiversity values and in some cases the values that are highlighted by the map may have been lost in the meantime (e.g. grassland paddocks converted to cropping, drained wetlands, cleared native vegetation). Comparing the maps with recent aerial photography and satellite imagery is a starting point for understanding if values are still present and require assessment. It does not replace the need for

expert advice from qualified ecologists, field surveys and on-ground assessments to determine risks for threatened bird and bat species based on site-specific factors.

### Criteria 2 – Are there site-specific characteristics that indicate threatened bird and bat species occur or are likely to occur on the site?

An examination of the characteristics of a proposed development site is an essential element in identifying potential impacts to threatened bird and bat species. Proponents should continue to carry out desktop analyses and site-specific surveys and assessments to identify the occurrence, or likely occurrence, density and abundance of threatened bird and bat species on the proposed site and to identify habitat or landscape features that are likely to be used by such species. Assessments may include acoustic surveys of bats and utilisation surveys for birds, detailed surveys of species behaviours and flight heights, and the development of collision risk or demographic models. This will inform identification and assessment of potential impacts on threatened bird and bat species from the construction and operation of the renewable energy facility.

If the site has one or more of the following characteristics, it is likely to represent a higher risk to threatened bird and bat species:

- one or more threatened bird or bat species are identified as being present at the site or in the surrounding area
- landscape features that may concentrate species' movements, such as rivers, wetlands or forest edges
- roosting, nesting or breeding sites, such as bat maternity caves or breeding wetlands for birds
- flocking areas
- feeding or foraging habitat.

For onshore wind energy facilities, priority should be given to identifying the occurrence, or likely occurrence, of Species of Concern and their supporting habitat and landscape features on the proposed development site. This may increase the risks of the site.

**Criteria 3 – Are there protected areas or important features surrounding the proposed development site that increase the likelihood the site will be used by threatened bird and bat species?**

To assess the potential risks of a renewable energy facility to threatened bird and bat species, it is important to consider the surrounding context of the proposed development site. Protected parks, reserves and conservation areas often host significant ecological and biodiversity communities and can be used by migratory or mobile species. There may also be important unprotected landscape features, such as maternity caves, roosting / breeding sites and flocking sites, that are used by threatened bird and bat species at critical life stages. The presence of these areas near to a development site can influence the risk posed because it can increase the likelihood that migratory or mobile species use or move through the site, there may be an increased number of threatened bird and bat species on or near the site, or there are threatened bird and bat species of different ages or sexes that might be more susceptible to impact or impacted more significantly (such as juveniles).

As part of assessing the surrounding area for the proposed development site, the following areas or features should be identified and considered to assess whether they influence the risk of the proposed site to threatened bird and bat species<sup>4</sup>:

- World Heritage Sites
- sites protected by the Ramsar Convention on Wetlands of International Importance
- wetlands utilised by designated species under the Japan-Australia Migratory Birds Agreement (JAMBA), the China-Australia Migratory Birds Agreement (CAMBA), or the Republic of Korea – Australia Migratory Birds Agreement (ROKAMBA)
- parks, reserves and conservation areas established under the *National Parks Act 1975*, *Crown Land (Reserves) Act 1978* or *Forests Act 1958*, particularly where the reservation purpose for the area includes protection of threatened bird and bat species

- established native vegetation offset sites or conservation covenants, particularly where the site has been established for threatened bird and bat species<sup>5</sup>
- landscape features that may concentrate species' movements, such as rivers, wetlands or forest edges
- roosting, nesting or breeding sites, such as bat maternity caves or breeding wetlands for birds
- flocking, feeding or foraging areas.

Identification and analysis of these areas can assist to map potential flight paths, migration and movement patterns into or through the proposed site and seasonal trends which are relevant to assess as part of identifying what threatened bird and bat species might use the site and what the potential risks might be from developing the site. The risk is likely to increase the closer the protected area or landscape feature is to the proposed site. Proponents can engage with DTP and DEECA to seek advice on what relevant factors should be considered in determining the extent of the surrounding area to be assessed. Proponents may also wish to engage with local landowners, First Nations people or Traditional Owners of the Country on which the proposed site is located, and community members to inform identification of relevant areas or features.

For onshore wind energy facilities, priority should be given to identifying the occurrence, or likely occurrence, of Species of Concern and the habitat and landscape features that may support them in areas surrounding the proposed development site.

If these protected areas or landscape features are located directly adjacent to the proposed development site, a project proponent may also need to consider appropriate placement of infrastructure, such as turbines, away from property boundaries to avoid impacting the biodiversity values of that area or feature.

<sup>4</sup> Information on areas of national or international importance can be found on the Environment Information Australia portal: <https://www.dcceew.gov.au/initiatives/eia-portal/explore-tools>

<sup>5</sup> Information on offset sites or conservation covenants could be obtained through engagement with neighbouring landowners or through land titles searches.

## 6.2 Identifying risks and impacts to threatened bird and bat species from the construction and operation of a renewable energy facility

There are a number of identified risks that arise from renewable energy facilities that can result in impacts to threatened bird and bat species. These are summarised in the table below, noting this list is not exhaustive.

**Table 2: Risks and impacts to threatened bird and bat species**

Risk	Project Stage	Potential impacts	Nature of impact
Habitat loss through clearance or displacement	Construction/ Operation	<p>Construction of infrastructure associated with renewable energy facilities typically requires removal of vegetation. This may cause habitat loss, degradation and fragmentation. This can result in mortalities and affect species richness and abundance, as well as impacting behaviours of mobile and migratory species (birds and bats).</p> <p>There may also be vegetation removal required as part of maintenance activity during operation of the renewable energy facility.</p> <p>The physical footprint of wind turbines and access roads as part of onshore wind energy facilities is usually relatively small. However, some bird and bat species avoid wind energy facilities, which results in displacement and effective loss of habitat.</p> <p>Removal of native vegetation will continue to be regulated under Clause 52.17 of local planning schemes and the <i>Guidelines for the removal, destruction or lopping of native vegetation</i>. However, consideration may also need to be given to other vegetation that threatened bird and bat species use for habitat or foraging or the displacement effect that a renewable energy facility may have on those species.</p> <p>The extent and significance of these impacts will depend on the flexibility of a species in its habitat use, and its ability to respond to changes in habitat conditions.</p>	Temporary, long-term or permanent
Disturbance	Construction/ Operation	Disturbance effects from a renewable energy facility could result in changes in the behaviour and/or reproductive success of threatened bird and bat species.	Temporary, long-term or permanent



Risk	Project Stage	Potential impacts	Nature of impact
Collision with renewable energy and transmission infrastructure	Operation	<p>Collision risk of wind energy facilities is perhaps the highest profile of all impacts. Birds and bats flying in the rotor swept area of wind turbines are potentially at risk of serious injury or death from collision.</p> <p>Key factors that influence the likelihood of collision are the heights that birds or bats fly in relation to the rotor swept area and the speed and direction of flight. Risk of a fatal collision will be modified by avoidance behaviour (resulting in decreased collision risk) and attraction behaviour (resulting in increased collision risk).</p> <p>Solar energy facilities could also present a collision risk to bird species, especially if panel surfaces are vertically oriented and/or reflecting light.</p> <p>Collision with above ground electricity transmission lines may lead to significant fatalities for some bird and bat species.</p> <p>There is also some evidence of collision risk associated with fences installed as part of renewable energy facilities.</p>	Long term or permanent
Displacement and barrier effects	Operation	<p>Locating multiple renewable energy facilities in the same landscape, in close proximity to each other, may create movement barriers or disrupt movement and migratory behaviours for threatened bird and bat species, potentially limiting their ability to access previously available habitat.</p> <p>Migratory birds may be particularly affected by wind energy facilities as they often travel in large flocks along set routes. Any obstacles blocking their flight paths can cause fatalities and/or cause them to burn crucial energy reserves diverting their route or abandon much-needed rest stops altogether.</p>	Long-term
Bird and bat mortality through electrocution on new electricity transmission lines	Operation	<p>Birds and/or bats may be electrocuted through perching on, or contact/collision with electricity transmission lines. Electrocution rates at the pylons (or poles) of low- or medium-voltage lines can be high and disproportionately affect some species that use pylons of low-voltage lines as perches when hunting or nesting.</p>	Permanent

Proponents should seek to identify early in the planning process what risks their proposed renewable energy facility may pose to threatened bird and bat species identified as occurring or likely to occur on the site through site and context analysis. This can assist with considerations about the potential likelihood, significance and nature of impacts and identification of the most suitable strategies and measures to apply under the mitigation hierarchy to address the risk factors and impacts.

For onshore wind energy facilities, priority should be given to identifying impacts on Species of Concern. More specific guidance on risks and impacts for Brolga [see **Appendix 2**] and bats [see **Appendix 3**] should be considered and applied.

It is acknowledged that there may be limited research and understanding of critical aspects of threatened bird and bat species behaviours, population dynamics, and significance of impacts from renewable energy facilities. Proponents are encouraged to seek to identify and address any uncertainty when conducting impact assessments or explain how uncertainty may impact outcomes of impact assessments.

As part of assessments of cumulative impacts, it may be relevant to consider if similar nearby renewable energy facilities have reported mortalities of a threatened bird and bat species and presence of that species has also been observed as occurring or likely to occur at the proposed development site.

### 6.3 Using the mitigation hierarchy to manage risks to threatened bird and bat species

The Government is committed to pursuing the renewable energy transition in a way that balances the needs of the energy industry with protecting Victoria's unique biodiversity. Once the site, construction and operational risks are identified and assessed, the mitigation hierarchy can be applied as part of the design response for the proposed renewable energy facility with the aim of achieving an acceptable level of impacts. In practice, this means the impacts on threatened bird and bat species caused by a renewable energy facility are balanced or outweighed by measures taken to avoid and minimise or mitigate the impacts and finally to compensate for the residual impacts.

The mitigation hierarchy is an internationally recognised tool of best practice for managing and mitigating impacts on biodiversity. It is already applied through environmental assessments under the EPBC Act and EE Act, and in the *Guidelines for the removal, destruction or lopping of native vegetation*. It is a logical framework based on the application of four distinct and successive actions – only after one stage of the mitigation hierarchy has been considered and applied can a proponent move on to the next. However, it prioritises prevention to avoid and minimise biodiversity impacts to the maximum extent practicable.

To support environment and planning assessment and approval processes, this Handbook sets out options for measures to avoid, minimise, mitigate and compensate for impacts on threatened bird and bat species that proponents should consider when applying the mitigation hierarchy. Which measures apply and to what extent will depend on the individual context of the development, what is reasonable and feasible in the circumstances and discussions between decision-makers and proponents.

For onshore wind energy facilities, priority should be given to applying measures that address impacts on Species of Concern. More specific guidance on measures applicable to impacts on Brolga [see **Appendix 2**] and bats [see **Appendix 3**] should be considered and applied.

#### Avoiding impacts

Avoidance is the first and most important step. It depends on proponents taking early action to anticipate and prevent impacts on threatened bird and bat species wherever reasonably possible. Avoiding impacts at the outset will mean fewer impacts will need to be managed through the assessment and approval process, resulting in fewer approval conditions to manage impacts.

Proponents are encouraged to choose development sites with lower biodiversity values and, once the site has been chosen, design the infrastructure to avoid impacting threatened bird and bat species within the chosen site.

The purpose of this stage of the mitigation hierarchy is to avoid as many impacts as reasonably possible. The following options are suggested for consideration:

Table 3: Options for avoidance measures

Options for avoidance measures	Relevant risk factors	Outcomes
<b>Strategic site selection</b>	Site risks to threatened bird and bat species; habitat loss; displacement; disturbance; collision	<p>Strategic level planning based on regional or landscape scale spatial information, such as the Habitat Value Map, and site and field surveys should be robust and sufficient to inform site selection and to allow for alternative sites to be considered.</p> <p>Proponents should be able to demonstrate why the site was selected and what biodiversity considerations informed that selection. For example, a multi-criteria analysis, early site selection and prioritisation.</p>
<b>Site level planning</b>	Site risks to threatened bird and bat species; habitat loss; displacement; disturbance; collision	<p>Avoid direct loss or degradation of sensitive habitat and decrease mortality risk of threatened bird and bat species through placement (e.g. micro-siting) of individual turbines or other infrastructure to avoid flight paths or sensitive habitat and landscape features and to reduce habitat fragmentation and barrier effects.</p> <p>Construction technique options (e.g. rerouting, marking or undergrounding electricity transmission lines, asset sharing).</p> <p>Turbine or infrastructure free corridors that enable movement through the site.</p> <p>The establishment of development exclusion zones within the site.</p> <p>Proponents should establish a comprehensive baseline, including identification of particularly sensitive areas on the project site and a good understanding of the biodiversity values of the site and behaviour of threatened bird and bat species. The Habitat Value Map may be used as a starting point to identify higher value areas for further assessment. Site-specific survey and data collection is required to consider how the proposed renewable energy facility may avoid impacts to threatened bird and bat species within the site selected.</p>



## Minimising impacts

Where impacts on biodiversity cannot be avoided, they should be minimised to the maximum extent practicable.

Appropriate and effective minimisation measures should be identified during early planning and design stages. The project design can ensure that high value habitat for threatened bird and bat species is minimally impacted. Measures to minimise impacts are primarily applied at design, construction and operation phases of the project.

Minimisation measures will vary depending on the type of renewable energy facility. The following options are suggested for consideration:

**Table 4: Options for minimisation measures**

Options for minimisation measures	Relevant risk factors	Outcomes
<b>Specific to onshore wind energy facilities</b>		
<b>Configuration of turbines on the site</b>	Displacement and barrier effects; disturbance; collision	<p>Options include:</p> <ul style="list-style-type: none"> <li>• a minimum distance between turbines</li> <li>• aligning turbines parallel to, and not across, bird or bat migration routes or general flight directions</li> <li>• arranging turbines in clusters with corridors between them that provide passage through the site</li> <li>• providing corridors between the site and other surrounding wind energy facilities to provide passage through the sites.</li> </ul> <p>These options can help to reduce barriers to bird or bat movement and minimise risk of collision by providing an opportunity for birds and bats to pass safely through the site.</p> <p>A suitable layout for wind turbines should consider migration or other movements (e.g. between roosting/nesting and feeding areas) of threatened bird and bat species. Determining a minimum distance between turbines may depend on the turbine type and the specific rotor swept area.</p>
<b>More general application to renewable energy facilities</b>		
<b>Buffer zones between infrastructure and important habitat and/or landscape features</b>	Habitat loss, disturbance, displacement, collision	<p>Reduces the likelihood of impact on important habitat or landscape features for threatened bird and bat species and possibility of collision.</p> <p>This could include locating renewable energy and associated infrastructure away from sensitive areas, limiting work vehicles and machinery to designated construction and access areas only and/or protecting existing vegetation by exclusion zones using fencing/ barriers.</p> <p>Buffer zone size and extent may vary depending on the impacted species and the type of renewable energy infrastructure.</p> <p>For insectivorous bats, habitat features may include treed areas, breeding or nesting sites, watercourses and waterbodies (e.g. wetlands, dams). For flying-foxes, buffering is specific to potential foraging trees and water sources. For birds, habitat features may include waterbodies and watercourses, forested/wooded areas, breeding sites or nest trees, known foraging habitat (e.g. preferred tree species).</p>
<b>Scheduling construction activity</b>	Displacement; disturbance; collision	<p>Changing the timing of construction activities to avoid disturbing threatened bird and bat species during sensitive periods of their lifecycle.</p> <p>Site-specific survey and data collection is required to consider seasonal aggregations (important/essential feeding, breeding and/or migratory periods) and diurnal/ nocturnal activity and movement patterns of threatened bird and bat species.</p>



## Mitigation measures

Mitigation measures should be considered and applied once all reasonable and practical steps have been taken to avoid and minimise impacts. The intent of mitigation measures is to manage unavoidable and ongoing impacts that are left after the avoid and minimisation measures have been applied. Mitigation measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided, as far as is practically feasible, can reduce how likely or significant the unavoidable impacts will be and are expected to last for the length of the project's operational life.

Consideration of appropriate mitigation measures will depend on the individual circumstances of the proposed renewable energy facility, the threatened bird and bat species likely to be impacted, and the

level of risk posed by the project in accordance with the risk criteria in this Handbook. It is acknowledged that there may be limited research and understanding of the effectiveness of some mitigation measures that are relatively untested in Victoria. Proponents are encouraged to be innovative and flexible in their use of mitigation measures. This may include the use of a combination of measures to achieve effective mitigation of impacts. When proposing to use untested measures or innovative approaches, proponents should identify any uncertainty, explain how uncertainty may impact mitigation outcomes, outline approaches to monitor, report and evaluate the measures and use adaptive management to address the uncertainty.

The following options are suggested for consideration:

**Table 5: Options for mitigation measures**

Options for mitigation measures	Relevant risk factors	Outcomes
<b>Specific to onshore wind energy facilities</b>		
<b>Low wind speed curtailment</b>	Collision	<p>Low wind speed curtailment is an increase in the cut-in speed at which turbines begin to produce energy during identified risk periods for birds and bats. This delay in operation reduces the likelihood of impacts.</p> <p>Curtailment measures may be in place permanently, or only during periods where there is known to be a heightened risk. The specific requirements will depend on the individual development and the Species of Concern.</p> <p>Various options exist to tailor this mitigation measure, including:</p> <ul style="list-style-type: none"> <li>the extent of curtailment across the proposed site, for example targeted at high-risk turbines or whole site</li> <li>the cut-in speed (m/s)</li> <li>time of the day/night, for example just at night if focusing on insectivorous bats</li> <li>ambient environmental factors, for example temperature in conjunction with wind speed, which is particularly relevant for bats</li> <li>seasonal, for example during bird or bat migration seasons or during the periods of highest mortality risk – i.e. late summer/autumn.</li> </ul> <p>Consideration can also be given to the use of smart curtailment, which involves the use of real-time species utilisation (such as the detection of target species echolocation calls) and/or environmental data to shut down turbines on a case-by-case basis to reduce bird or bat fatalities while maximising energy production.</p> <p>On demand shutdown can reduce the risk of impacts occurring by shutting down turbines when a collision risk for a bird or bat species is detected. There are several types of on demand shut down technology either being trialled or in development, including radar, thermal/infrared cameras, visual detection cameras, weather radar or acoustic detectors.</p> <p>These technologies are installed at the project site and used to detect particular bird or bat species. They enable shut down of turbines in real time when a species is detected approaching turbines and is at risk of collision. These have mainly been developed for birds, with fewer options yet available for bats.</p>

Options for mitigation measures	Relevant risk factors	Outcomes
<b>Prevent turbines from spinning below the manufacturer cut-in speed</b>	Collision	Energy production does not commence until the manufacturer's cut-in speed is reached, typically 3 m/s. Below this speed freewheeling blades can kill bats and birds. Locking or feathering the blades stops the blades from turning when no energy is being produced, which can reduce mortality rates of birds and bats without reducing energy production.
<b>Increasing the visibility of infrastructure to warn bird species of its presence</b>	Collision – birds	This could take different forms, for example increasing visibility of rotor blades by marking one blade a different colour or attaching bird flight diverter products to powerlines. Increased visibility improves the chances that diurnal bird species will see and avoid the turbines.
<b>Installation of acoustic deterrent devices (ADD) to deter species</b>	Collision – bats	Installation of devices on turbines to deter bats from approaching by emitting noise within the frequency of the echolocation calls of targeted species. By encouraging bats to avoid the turbines, acoustic deterrence may reduce the likelihood of impacts occurring <sup>6</sup> .
<b>Turbine height</b>	Collision	Blade heights and rotor swept areas designed to operate above, or below, certain heights may avoid impinging on the flight paths of certain threatened bird and bat species.
<b>Land management actions that reduce the potential for birds or bats to be attracted to the facility</b>	Collision	By minimising the factors that might attract threatened bird and bat species into the vicinity of wind energy facilities these measures can reduce the risk of impacts to such species occurring. This could take many forms, including: <ul style="list-style-type: none"> <li>• ensuring prompt and regular clearance of carcasses of birds or bats or livestock to avoid attracting birds of prey</li> <li>• avoiding lambing under footprint of turbine to avoid attracting birds of prey</li> <li>• shutting down turbines during stubble burning</li> <li>• limiting access to water sources in the immediate vicinity of the turbines.</li> </ul>
<b>More general application to renewable energy facilities</b>		
<b>Configuration of electricity transmission lines</b>	Collision	Reduces the risk of threatened bird or bat species colliding with electricity transmission lines. Options include: <ul style="list-style-type: none"> <li>• underground electricity transmission lines</li> <li>• attaching devices (typically flappers, balls or spirals) to electricity transmission lines to increase their visibility</li> <li>• design or insulation of poles and wires to reduce the risk of electrocution of birds or bats from contact</li> <li>• design measures to reduce the vertical spread of lines, increase the visibility of lines, and/or decrease the span length.</li> </ul>
<b>Modify fencing to minimise barrier effects</b>	Displacement and barrier; Collision	Reduces the risk of threatened bird or bat species colliding with or being displaced by fencing. Options include: <ul style="list-style-type: none"> <li>• creating passageways by modifying the fence to facilitate movement of bird or bat species</li> <li>• using plain rather than barbed wire, especially for the top strand, to avoid bird or bat entanglement.</li> </ul>

<sup>6</sup> Noting future testing of the effectiveness of this approach is required.

## Compensatory measures

It is possible that, even after the rigorous application of avoidance, minimisation and mitigation measures, there are ongoing risks and residual impacts of a proposed renewable energy facility for threatened bird and bat species that need to be addressed for the project to demonstrate it can achieve an acceptable level of impacts. When used effectively, compensatory measures not only allow proponents greater flexibility in meeting their regulatory obligations, but can also contribute to better overall outcomes for impacted threatened bird and bat species.

This Handbook provides guidance for proponents and decision-makers regarding:

- when it is appropriate to rely on compensatory measures to manage ongoing risks and residual impacts on threatened bird and bat species using a risk-based approach
- what forms of compensation may be used
- what information is required from a proponent seeking to use compensatory measures
- what factors will be considered when evaluating the merits of a compensation proposal.

As required by environmental assessment processes under the EPBC Act and EE Act, a proponent should only consider compensation options after the other steps in the mitigation hierarchy have been applied to the maximum extent practicable and the residual impacts have been identified.

## Defining residual impact using a risk-based approach

Compensatory measures to address adverse residual impacts to threatened bird and bat species from a proposed renewable energy facility can be identified by considering the ongoing risks to those species from the project. The scale and extent of residual impacts will vary from project to project and may be difficult to precisely quantify in practice for some threatened bird or bat species where there is limited data.

This Handbook provides guidance on the risks a proposed renewable energy facility may pose to threatened bird or bat species, as well as the impacts arising from those risks and whether they are short-term, long-term or permanent impacts [see **Sections 6.1 and 6.2**]. Residual impacts are most likely to occur where risks from a project are ongoing and result in long-term or permanent impacts. Consideration can therefore be given to the type of risk and what impacts it causes to identify measures that can be used to compensate for that impact. Consideration should also be given to:

- the significance of the risks posed by the development prior to the application of measures under the mitigation hierarchy
- the extent to which the proponent has reduced risks and impacts through the application of avoid, minimise or mitigation measures under the mitigation hierarchy.

In assessing the residual impacts of a proposed renewable energy facility, the proponent should be able to provide sufficient information and/or data to demonstrate the following:

- the types of risks from the project (e.g collision risk, displacement risk, disturbance risk) that are likely to result in long-term or permanent impacts to threatened bird and bat species
- the measures that the proponent proposes to use to avoid, minimise or mitigate those impacts and the extent to which those measures are predicted to reduce risk or the level of significance of impact
- the significance of the residual impacts that remain
- the specific threatened bird or bat species to which those risks apply (for example, Species of Concern for onshore wind energy facilities).

### What form of compensation may be used?

There are two broad types of compensation measures available to proponents to manage residual impacts on threatened bird or bat species from renewable energy facilities:

- **Direct compensation:** carrying out, either directly or by engaging a third party, on-ground actions that directly benefit the impacted threatened bird and/or bat species' populations.
- **Indirect compensation:** delivering, either directly or by funding a third party, research or education outcomes and/or programs that are designed to indirectly benefit the impacted threatened bird or bat species by helping to address key knowledge gaps in species' behaviour, fecundity, habitat and other matters that are essential to ensuring their long-term survival.

The aim of any compensatory measure is to improve the conservation and population outcomes of an impacted threatened bird or bat species overall. This reflects the reality that threatened bird or bat species have become threatened and remain so due to a multitude of factors.

Proposals for compensatory measures may be guided by:

- recommendations for actions in species' Action Statements prepared by DEECA under section 19 of the FFG Act
- Specific Needs Assessment (SNA), if one has been prepared by DEECA
- recommendations in National Recovery Plans prepared by the Commonwealth Government under section 269A of the EPBC Act.

The actions in these documents are scientifically robust and, if pursued, will contribute to the overall conservation of the threatened bird or bat species.

In cases where no Action Statement, SNA or National Recovery Plan exist, or where the proponent wishes to develop their own compensation approach, the proponent may work with DEECA to develop and agree other compensatory measures that will be undertaken. Consideration may also be given to using DEECA's Strategic Management Prospects (SMP) in NatureKit, which is a spatially explicit tool that shows where and how cost-effective action can be taken to guide on-ground management that makes the biggest difference for as many species as possible across Victoria.

Where an impacted threatened bird or bat species has been identified by Traditional Owners and First Nations people as having cultural significance, proponents are also encouraged to engage with and seek advice from Traditional Owner Corporations or First Nations representatives in developing appropriate compensatory measures. A Traditional Owner Corporation or First Nations group may be able to deliver the compensatory measures on behalf of the proponent.

### Options for direct compensation actions

In line with the risk-based approach outlined in this Handbook, direct compensation actions should specifically relate to addressing the residual impacts to threatened bird and bat species arising from the risks of the proposed renewable energy facility to enable an acceptable level of impact to be achieved. Direct compensation actions may broadly fit into the following categories, but should be tailored to align with conservation priorities for the threatened bird or bat species and the extent and significance of the residual impact:

- permanent protection and management of existing habitat or landscape features important for the impacted threatened bird or bat species
- revegetation, enhancement or rehabilitation that improves the quality of habitat important for the impacted threatened bird or bat species
- creation of new protected areas of habitat or landscape features important for the impacted threatened bird or bat species
- reducing or managing other threats to the threatened bird or bat species, such as pest and predator controls.



### Options for indirect compensation actions

Proposals for indirect compensation actions should also relate to addressing the residual impacts to threatened bird and bat species arising from the risks of the proposed renewable energy facility. Examples could include, but are not limited to:

- increasing understanding of population dynamics and life history, such as developing robust models to estimate likely impacts of threats on population viability
- conducting surveys to determine total minimum population size and estimate range
- developing techniques to accurately estimate population numbers, survival rates and breeding success
- determining survival rates of various age and sex cohorts
- increasing understanding of behaviours of threatened bird and bat species and their ability to adapt to barriers in the landscape or displacement
- increasing understanding of the level of effectiveness of mitigation measures for impacts on threatened bird and bat species.

The intention of such indirect compensation is to improve our understanding of the impacted threatened bird and bat species, which is essential to improving the effectiveness of mitigation measures and on-ground actions and their chances of survival.

### Developing a compensation proposal

When developing a compensation proposal, a proponent should consider the following key factors:

- the scale, amount or type of compensatory measure/s that is proportionate to and will adequately compensate for the assessed residual risk and impacts to achieve an acceptable level of impact
- compensatory measures should aim to contribute to the overall conservation of a threatened bird or bat species, taking into account the range of threats and impacts
- indirect compensation actions may only be used in combination with direct compensation actions depending on the needs of the impacted threatened bird or bat species, noting a limit may be placed on the use of indirect compensatory measures

- compensatory measures must be additional to what is already required by other laws or planning provisions
- compensatory measures must be reasonable, timely, transparent and based on the best available science and/or information.

Whether proposed compensatory measures are appropriate and acceptable will be decided on a case-by-case basis and will depend on whether it can be demonstrated that the activity will benefit the threatened bird or bat species, the level of scientific uncertainty regarding the significance of impacts or effectiveness of mitigation measures and availability of other compensation options.

Proponents can deliver compensation measures directly or in partnership with volunteer organisations, academic institutions, Traditional Owners and First Nations groups and/or private landowners. Measures that provide an opportunity for proponents to work with Traditional Owners and First Nations groups to support reading and healing Country are highly encouraged. Where a proponent is working with or reliant on partners to deliver compensatory measures this should be clearly indicated.

## 6.4 Demonstrating application of the mitigation hierarchy to manage risks

A proponent should be able to demonstrate in their planning permit application or environmental impact assessment documents that options chosen under the mitigation hierarchy to address identified risks and impacts are sufficient to achieve an acceptable level of impact for the proposed renewable energy facility. A statement demonstrating application of the mitigation hierarchy could be included as part of an Environmental Management Plan, EES or Environment Report, Bat and Avifauna Management (BAM) Plan or could be a separate 'Species Mitigation and Compensation Plan'.

The following matters should be addressed as part of any statement:

Table 6: Matters to address when demonstrating application of the mitigation hierarchy

Matter to be addressed	Description
<b>Description of project risks and impacts</b>	<ul style="list-style-type: none"> <li>Describe the threatened bird and bat species affected and key risks. For onshore wind energy facilities, identify key risks to Species of Concern.</li> <li>Describe the project's impacts on threatened bird and bat species (including direct, indirect, and cumulative impacts, as appropriate). For onshore wind energy facilities, describe impacts to Species of Concern.</li> </ul>
<b>Description of measures for avoidance, minimisation and mitigation</b>	<ul style="list-style-type: none"> <li>Describe the measures for avoidance of impacts and the rationale for selecting them, including those taken to avoid impacts and risks to highly irreplaceable and/or vulnerable biodiversity values.</li> <li>Describe the measures for minimisation of impacts and the rationale for selecting them.</li> <li>Describe the measures for mitigation of impacts and the rationale for selecting them.</li> <li>Using the best available information, describe how effective such measures are likely to be to avoid, minimise or mitigate impacts or reduce the significance of impacts. This could include evidence from species experts, on ground assessments or surveys or evidence of successful use of the measure from other developments and/or jurisdictions.</li> </ul>
<b>Description of residual impacts</b>	<ul style="list-style-type: none"> <li>Describe the residual impacts on threatened bird and bat species based on ongoing risks, which remain after avoidance, minimisation, and mitigation measures are adopted.</li> <li>Describe the level of risk or uncertainty that any of these residual impacts are not capable of being compensated for.</li> </ul>
<b>Description of compensatory measures</b>	<ul style="list-style-type: none"> <li>Describe the compensatory measures, the rationale for selecting them and how they seek to address residual impacts.</li> <li>Describe if and how stakeholders were identified and involved in proposing and/or designing the compensatory measures.</li> <li>Using the best available information, describe how effective such compensatory measures are likely to be to address residual impacts. This could include evidence from species experts, on ground assessments or surveys or evidence of successful use of the measure from other developments and/or jurisdictions.</li> </ul>
<b>Description of implementation of measures</b>	<ul style="list-style-type: none"> <li>Describe arrangements for delivering the measures under the mitigation hierarchy.</li> <li>Describe the financial arrangements for implementation of the measures.</li> <li>Describe the milestones for implementation.</li> <li>If third parties are to be involved in the delivery of compensatory measures: <ul style="list-style-type: none"> <li>define the roles and responsibilities</li> <li>outline agreements / arrangements to be established with those parties, including how any disputes or disagreements will be managed</li> <li>provide evidence for management and technical capacity of the third parties chosen.</li> </ul> </li> <li>Describe any sources of uncertainty and risk and identify measures to manage them.</li> <li>Optional: outline a mechanism for independent audit or review of design and implementation of compensatory measures.</li> </ul>
<b>Monitoring, reporting, evaluation and adaptive management</b>	<ul style="list-style-type: none"> <li>Describe the measures for monitoring, evaluation, reporting and adaptive management of implementation of the measures under the mitigation hierarchy.</li> <li>Describe implementation and operational milestones and how progress will be tracked.</li> </ul>

The statement demonstrating application of the mitigation hierarchy will be considered as part of assessing a planning permit application and/or environmental assessment. The following matters may be taken into account:

- Has the proponent accurately and comprehensively identified all the relevant risks and potential impacts to threatened bird and bat species from the proposed renewable energy facility?
- Where the proposal is for an onshore wind energy facility, has the proponent accurately and comprehensively identified all the relevant risks and potential impacts to Species of Concern?
- Are any of the identified threatened bird and bat species listed as 'Critically Endangered' under the FFG Act? This reflects the clear need to exercise caution when assessing the impacts on a species already at significant risk of extinction.
- Has the proponent undertaken all reasonable steps to apply the successive stages of the mitigation hierarchy, including avoidance, minimisation, mitigation and compensation?
- Is the information and/or data provided by the proponent to support their assessment adequate?
- Is there a limited understanding/ knowledge of critical aspects of a threatened bird or bat species (behaviour, population dynamics, etc.)? This reflects the highly variable state of knowledge of many species.
- Is there a limited understanding/knowledge of the effectiveness of the proposed avoid, minimise, mitigation or compensatory measure? How does the proponent propose to address the uncertainty?
- Has the risk-based approach outlined in this Handbook been adequately applied to the proposed renewable energy facility to support assessment of whether the project can achieve an acceptable level of impact?

Additional information may be requested to support consideration of these questions.



## 7. Monitoring, Reporting and Adaptive Management

Monitoring and reporting requirements play an essential role in improving understanding of the interactions between renewable energy facilities and threatened bird and bat species. Monitoring and reporting activities provide a mechanism to assess whether predictions of impacts made before and during the assessment and approval processes are accurate. Differences between predicted and measured impact may arise because:

- even after best efforts have been made to avoid and minimise impacts, impacts will still occur at some level and are difficult to accurately predict upfront
- behaviour and activity of threatened bird and bat species can change after construction of the renewable energy facility due to attraction and avoidance behaviours or unforeseen changes in species abundance and distribution.

Information obtained through monitoring and reporting assists with conservation efforts for the threatened bird and bat species impacted and understanding the extent of population impacts that may arise from renewable energy facilities to help manage them into the future.

Monitoring, reporting and adaptive management requirements will be determined for each renewable energy project on a case-by-case basis, taking into account the risks of the proposal, the nature, extent and significance of potential impacts and the level of uncertainty about impacts or effectiveness of measures under the mitigation hierarchy to be applied. Requirements for monitoring, reporting and adaptive management may be specified in planning permit conditions.

Guidance on methods for post-construction mortality monitoring for birds and bats from wind energy facilities is provided in **Appendix 4**.

### 7.1 Determining the length of the monitoring and reporting period

Monitoring should commence immediately after the renewable energy facility is commissioned and starts operating. Where the facility is developed and commissioned in stages, a proponent should consult with DEECA and DTP to determine the appropriate monitoring regime.

The monitoring and reporting period may be determined depending on the specifics of the project, the risks and impacts to threatened bird and bat species and the level of effectiveness or uncertainty of measures adopted under the mitigation hierarchy.

However, it is recommended that the default monitoring period is for the operational life of the renewable energy facility, with variable options to consider implementing during that time including:

- continuous monitoring for the first two to five years to allow for an understanding of yearly variation in mortality, the threatened bird and bat species impacted, and the effectiveness of any avoid, minimise or mitigation measures being implemented to manage these impacts
- subsequent periods of short-term follow-up monitoring triggered by events specified in management plans, such as extreme weather events, or spot monitoring for additional years for example during pre-defined seasons of high species activity, to support understanding of longer-term possible changes to impact levels and the effectiveness of any avoid, minimise or mitigation measures being implemented to manage these impacts.

Monitoring for short periods (e.g. less than two years) results in a high risk of missing normal variability across years or due to infrequent events like droughts. For instance, data from monitoring of wind energy facilities in Victoria and other jurisdictions shows considerable variation in mortality rates of threatened bird and bat species between years, and that new species detected as mortalities can continue to increase for up to 10 years. Ongoing impacts estimated from monitoring data generated over less than two years would therefore have more uncertainty. Longer monitoring periods can provide more certainty of the level of ongoing impacts and whether measures adopted to avoid, minimise or mitigate impacts are effective.

### 7.2 Bat and Avifauna Management (BAM) Plans for onshore wind energy facilities

BAM Plans set out the monitoring, reporting and adaptive management obligations for proponents once a wind energy facility is approved and has commenced operation. BAM Plans may specify triggers for applying adaptive management measures.

The requirement to complete and implement a BAM Plan to monitor, report on and manage impacts on threatened bird (avifauna) and bat species from onshore wind energy facilities may be applied as a condition of planning approval. However, the specific monitoring, reporting and adaptive management requirements to include in a BAM Plan may vary depending on the project, the risks and impacts to threatened bird or bat species and the level of effectiveness or uncertainty of measures adopted under the mitigation hierarchy.

**Appendix 5** of this Handbook provides further guidance on information to include in BAM Plans.

# Appendix 1: Species of Concern List for Onshore Wind Energy Facilities

The Species of Concern List was developed by DEECA's Arthur Rylah Institute for Environmental Research (ARI) using a science-based approach that involved species experts assessing all Victorian threatened bird and bat species and is transparent and repeatable<sup>7</sup>.

Using the information and data available from existing wind energy facilities supported by expert opinion, ARI identified which species of birds or bats were at risk based on:

- Listed as threatened under the FFG Act or the EPBC Act
- How high the species flies
- Habitat preference
- Concentration of population in localised areas
- Demographic resilience
- Population size
- Conservation status.

The level of risk from onshore wind energy facilities, and therefore the level of concern for the conservation of the species, varies from 'minimal' to 'mild' to 'concern' to 'extreme concern'. Those species that were judged to be most at risk make up the Species of Concern List because of the likelihood and the consequences of their interactions with operational turbines.

## The 2024 list of Species of Concern relevant to onshore wind energy facilities

FFG Act and EPBC Act threatened status: CR Critically Endangered, EN Endangered, VU Vulnerable. Some species are listed under the EPBC Act as Migratory, which is separate to being listed under the threatened categories. Species that have been recorded as mortalities at Victorian wind energy facilities are indicated.

**Table 7: Species of Concern List**

Common name	Scientific name	Group	FFG Act	EPBC Act threatened	EPBC Act Migratory	Recorded fatalities
<b>BATS – Probable concern</b>						
Southern Bent-wing Bat	<i>Miniopterus orianae bassanii</i>	Bats	CR	CR		Yes
Eastern Bent-wing Bat	<i>Miniopterus orianae oceanensis</i>	Bats	CR			
South-eastern Long-eared Bat	<i>Nyctophilus corbeni</i>	Bats	EN	VU		
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	Bats	VU			
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Bats	VU	VU		Yes
<b>BIRDS – Probable concern</b>						
Gull-billed Tern	<i>Gelochelidon nilotica</i>	Gulls, Terns	EN		Yes	
Little Tern	<i>Sternula albifrons</i>	Gulls, Terns	CR		Yes	
Fairy Tern	<i>Sternula nereis</i>	Gulls, Terns	CR	VU		
Australian Bustard	<i>Ardeotis australis</i>	Ground dwelling birds	CR			
Bush Stone-curlew	<i>Burhinus grallarius</i>	Ground dwelling birds	CR			

<sup>7</sup> [https://www.environment.vic.gov.au/home/managing-impacts-of-renewable-energy-on-environment/species-of-concern-list-nov-2024\\_e2fb-2.pdf](https://www.environment.vic.gov.au/home/managing-impacts-of-renewable-energy-on-environment/species-of-concern-list-nov-2024_e2fb-2.pdf)



Common name	Scientific name	Group	FFG Act	EPBC Act threatened	EPBC Act Migratory	Recorded fatalities
Plains-wanderer	<i>Pedionomus torquatus</i>	Ground dwelling birds	CR	CR		
Regent Honeyeater	<i>Anthochaera phrygia</i>	Land birds	CR	CR		
Fork-tailed Swift	<i>Apus pacificus</i>	Land birds			Yes	Yes
White-throated Needletail	<i>Hirundapus caudacutus</i>	Land birds	VU	VU	Yes	Yes
Major Mitchell's Cockatoo	<i>Lophochroa leadbeateri</i>	Parrots	CR	EN		
Scarlet-chested Parrot	<i>Neophema splendida</i>	Parrots	EN			
Red-tailed Black Cockatoo	<i>Calyptrorhynchus banksii graptogyne</i>	Parrots	EN	EN		
Swift Parrot	<i>Lathamus discolor</i>	Parrots	CR	CR		
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	Parrots	CR	CR		
Elegant Parrot	<i>Neophema elegans</i>	Parrots	VU			
Eastern Osprey	<i>Pandion haliaetus</i>	Raptors, Owls			Yes	
Grey Goshawk	<i>Accipiter novaehollandiae</i>	Raptors, Owls	EN			
Grey Falcon	<i>Falco hypoleucos</i>	Raptors, Owls	VU	VU		
Black Falcon	<i>Falco subniger</i>	Raptors, Owls	CR			Yes
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Raptors, Owls	EN			Yes
Little Eagle	<i>Hieraaetus morphnoides</i>	Raptors, Owls	VU			Yes
Square-tailed Kite	<i>Lophoictinia isura</i>	Raptors, Owls	VU			
Barking Owl	<i>Ninox connivens</i>	Raptors, Owls	CR			
Masked Owl	<i>Tyto novaehollandiae</i>	Raptors, Owls	CR			
Red Knot	<i>Calidris canutus</i>	Shorebirds	EN	VU	Yes	
Great Knot	<i>Calidris tenuirostris</i>	Shorebirds	CR	VU	Yes	
Lesser Sand Plover	<i>Charadrius mongolus</i>	Shorebirds	EN	EN	Yes	
Eastern Curlew	<i>Numenius madagascariensis</i>	Shorebirds	CR	CR	Yes	
Whimbrel	<i>Numenius phaeopus</i>	Shorebirds	EN		Yes	

Common name	Scientific name	Group	FFG Act	EPBC Act threatened	EPBC Act Migratory	Recorded fatalities
Australian Painted Snipe	<i>Rostratula australis</i>	Shorebirds	CR	EN		
Grey-tailed Tattler	<i>Tringa brevipes</i>	Shorebirds	CR		Yes	
Wood Sandpiper	<i>Tringa glareola</i>	Shorebirds	EN		Yes	
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Shorebirds	EN		Yes	
Terek Sandpiper	<i>Xenus cinereus</i>	Shorebirds	EN	VU	Yes	
Intermediate Egret	<i>Ardea intermedia plumifera</i>	Waterbirds	CR			
Little Egret	<i>Egretta garzetta nigripes</i>	Waterbirds	EN			
Australian Little Bittern	<i>Ixobrychus dubius</i>	Waterbirds	EN			
Magpie Goose	<i>Anseranas semipalmata</i>	Waterbirds	VU			
Brolga	<i>Antigone rubicunda</i>	Waterbirds	EN			Yes
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Waterbirds	CR	EN		
Glossy Ibis	<i>Plegadis falcinellus</i>	Waterbirds			Yes	
<b>BIRDS – Precautionary concern</b>						
Common Tern	<i>Sterna hirundo</i>	Gulls, Terns			Yes	
Red-chested Button-quail	<i>Turnix pyrrhothorax</i>	Ground dwelling birds	EN			
Night Parrot	<i>Pezoporus occidentalis</i>	Parrots		EN		
Superb Parrot	<i>Polytelis swainsonii</i>	Parrots	EN	VU		
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Parrots	EN	EN		
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	Parrots	VU	VU		
Sooty Owl	<i>Tyto tenebricosa</i>	Raptors, Owls	EN			
Bar-tailed Godwit	<i>Limosa lapponica</i>	Shorebirds	VU	EN	Yes	
Black-tailed Godwit	<i>Limosa limosa</i>	Shorebirds	CR	EN	Yes	
Inland Dotterel	<i>Peltohyas australis</i>	Shorebirds	VU			
Eastern Great Egret	<i>Ardea alba modesta</i>	Waterbirds	VU		Yes	
Freckled Duck	<i>Stictonetta naevosa</i>	Waterbirds	EN			

# Appendix 2: Species Specific Guidance for Onshore Wind Energy Facilities – Victorian Brolga

Subject to application of the transitional provisions in section 4.6 of the Handbook, this guidance replaces the *Interim Guidelines for the Assessment, Avoidance, Mitigation and Offsetting of Potential Wind Farm Impacts on the Victorian Brolga Population 2011, Revision 1 February 2012* (DSE 2012)<sup>8</sup>.

## 1. Brolga ecology

The Brolga is a long-lived bird that can live up to 30 years but have an average lifespan of around eight years in the wild. Like many crane species, they are highly wetland dependant throughout their entire lifecycle and require access to wetlands for breeding, roosting and foraging. Dryland habitat surrounding wetlands is important for foraging and includes cropping and grazing land. Brolga spend part of the year flocking before dispersing from flocking areas to breeding sites. At the end of the breeding season, most Brolga pairs and their young return to flocking areas for the flocking season. Some pairs may remain at or near breeding sites throughout the year.

### 1.1 Flocking

Brolga flocking areas provide habitat for Brolgas to drink, roost and feed during the drier months and are used by Brolgas until the following breeding season. Most flocking areas in Victoria are on private land. A flocking area comprises the wetland and non-wetland areas used by a Brolga flock (ten or more Brolgas) for roosting and feeding during the Brolga flocking season.

In Victoria, the Brolga flocking season is during the drier months of the year in summer and autumn, predominately from December to June.

### 1.2 Breeding

Once a breeding territory (incorporating the breeding home range) is established, Brolga tend to return to the same breeding site in subsequent years. As Brolgas reach maturity, they will pair up and select a breeding site when they are about three years old.

When selecting new breeding territories, there are preferred habitat characteristics. Brolgas require water to breed and prefer shallow, well-vegetated and seasonally inundated wetlands, primarily in temporary freshwater marshes and meadows wetland types. The south-west of Victoria is one of the regions where such wetland types are most abundant, although the Wimmera and northern Victoria also contain such habitats. Semi-permanent and permanent waterbodies are also known to be used by Brolgas for breeding (including farm dams), so long as the waterbody has extensive shallows with vegetation.

## 2. Risks to Brolga from the operation of wind energy facilities

The Brolga is listed as endangered under the FFG Act as it faces a high risk of extinction in Victoria. Wind energy facilities have the potential to impact Brolga breeding and flocking success. This guidance seeks to enable Victoria's energy transition while also protecting the Victorian Brolga from impacts during the development and operation of wind energy facilities and associated infrastructure.

Wind energy facility developments occur in Brolga habitat across the Brolga area of interest.

Small numbers of mortalities can pose a significant risk to the Brolga, because the species is long-lived, has a low reproductive rate and a small and declining population size.

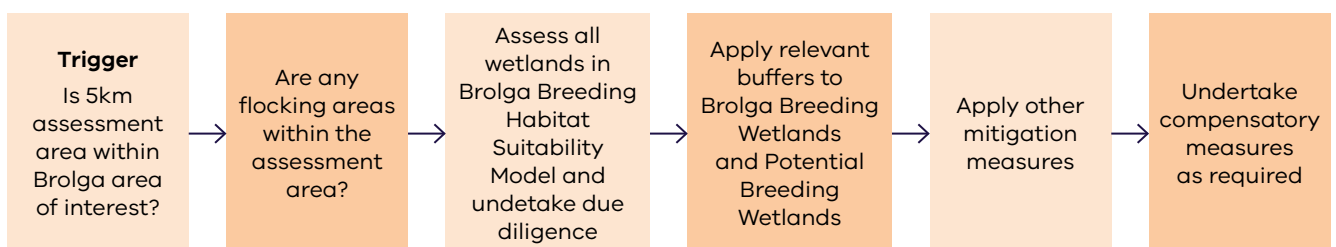
<sup>8</sup> <https://www.environment.vic.gov.au/home/managing-impacts-of-renewable-energy-on-environment>

The risk to Brolga varies between flocking, migration and breeding seasons:

**Table 8: Risks to Brolgas**

Feature/ Behaviour	Risk	Description
<b>Brolga flocking areas</b>	Habitat loss, disturbance and collision with turbines, electricity transmission lines and fences	Based on annual survey results, it is estimated that 70 to over 90 per cent of the Victorian Brolga population flock annually within the Brolga flocking areas during the drier months of the year, predominately December to June. Any impact to these areas has the potential to impact a significant proportion of the Victorian Brolga population due to the large number of Brolga concentrated at flocking areas, greater number of daily flights and flight length.
<b>Brolga Breeding Wetlands</b>	Habitat loss, disturbance and collision with turbines, electricity transmission lines and fences	<p>Risk of reduced breeding success due to habitat loss, disturbance and collision, noting there is a low risk of collision with wind turbines, with appropriate buffers reducing this further.</p> <p>Brolgas have low breeding success rate in surviving from egg incubation to fledgling. Once a breeding territory is established, Brolgas tend to return to the same breeding site in subsequent years. Some wetlands have been known to support Brolga breeding for nearly 20 years. Protection of Brolga Breeding Wetlands is very important to maximise fledging success.</p>
<b>Brolga migration</b>	Collision	While there is a low risk of collision with wind turbines during migration between flocking areas and breeding sites, a small number of collisions could have an impact on the Victorian Brolga population. The application of appropriate buffers at flocking areas and breeding sites can reduce the likelihood of collision further.

### 3. Process for applying this guidance



#### 3.1 Map the assessment area

The assessment area is a 5-kilometre (km) radius measured from the title boundaries of the wind energy facility and electricity transmission line(s) and includes the land subject to the planning permit application. If the boundary of the assessment area goes through a wetland that requires assessment for the purposes of this guidance, the whole wetland should be included in the assessment area.

Proponents should produce an assessment area map for the application showing the proposed wind energy facility site, including any associated infrastructure, with the 5km assessment area clearly demarcated. The map must include a legend and a scale bar. The steps below indicate any additional information that must be added to the assessment area map in preparation for a planning permit application.

### 3.2 When does this guidance apply?

The guidance only applies to planning permit applications, and any necessary environmental impact assessment, for:

- a wind energy facility
- an electricity transmission line directly associated with a wind energy facility to connect the facility to the electricity network.

The guidance applies if any part of the assessment area of a planning permit application falls within any part of the Brolga area of interest (Figure 1).

Proponents must determine whether any part of the assessment area is within the Brolga area of interest by overlaying the assessment area onto the Brolga area of interest. The Brolga area of interest can be obtained from <https://www.environment.vic.gov.au/home/managing-impacts-of-renewable-energy-on-environment>.

If no part of the assessment area falls within the Brolga area of interest, then this guidance does not apply.



Figure 1: A map of the Brolga area of interest where the guidance applies in Victoria



### 3.3 Assessment requirements

Assessments to identify Brolga flocking areas and Brolga Breeding Wetlands require engagement with local residents, representatives of local environmental agencies and council, and community environment groups. For Brolga flocking areas, the engagement should be included as part of the due diligence process to ensure there are no unmapped Brolga flocking areas within (wholly or in part) the assessment area. For Brolga Breeding Wetlands, the engagement can help to identify Brolga Breeding Wetlands that may not be identified through desktop assessment or field surveys.

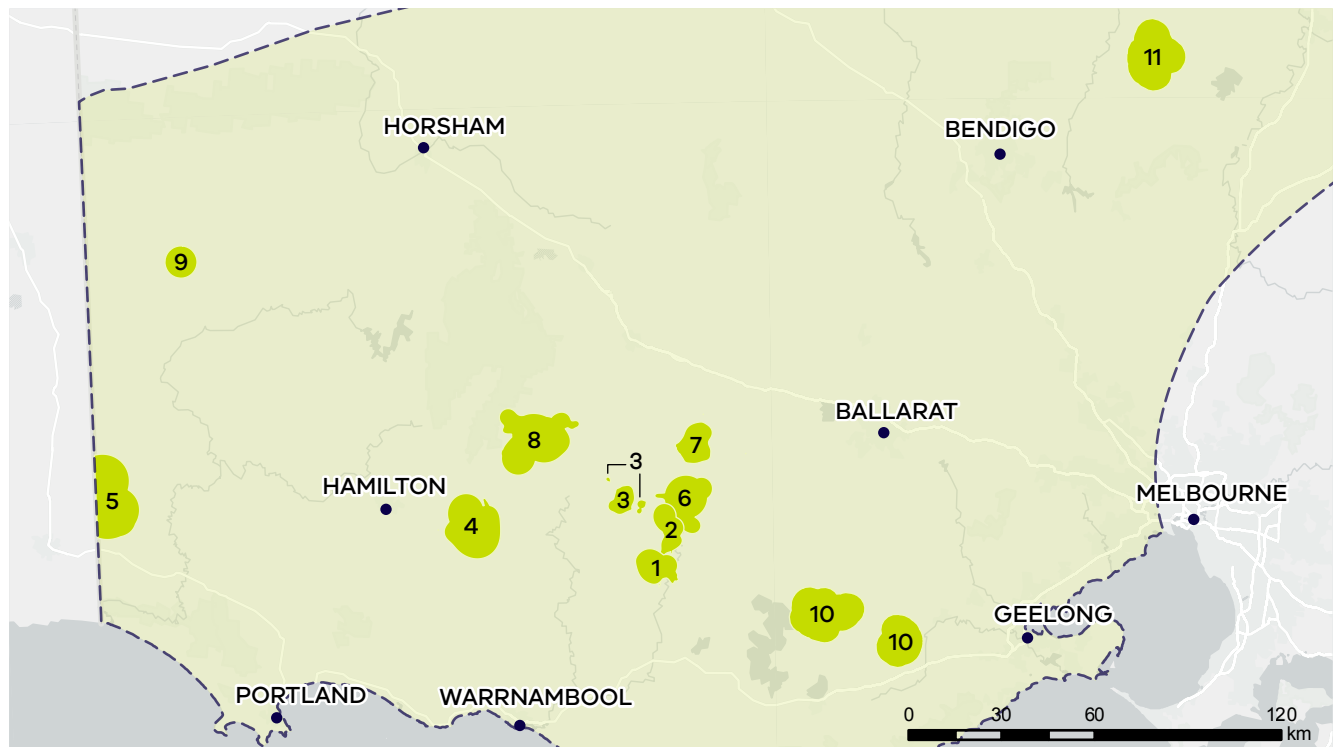
Where the assessment requirements refer to creation of maps or assessing spatial elements (such as whether any part of the use or development falls within the Brolga area of interest), it is assumed that this will be completed using a suitable Geospatial Information System.

### Identifying Brolga flocking areas

Brolga flocking areas are to be avoided for the development of wind energy facilities. A flocking area comprises the wetland and non-wetland areas used by a Brolga flock (ten or more Brolgas) for roosting and feeding during the flocking season.

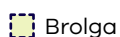
DEECA has prepared a flocking areas map (Figure 2) that clearly outlines the Brolga flocking areas that are to be avoided. This map has been developed based on flocking season home ranges derived from GPS tracking data and annual surveys of these flocking areas conducted by DEECA since 2009. It is estimated that 70 to over 90 per cent of the Victorian Brolga population flock annually within the Brolga flocking areas. Each flocking area differs in size and shape because some support larger flocks than others.

The Brolga flocking areas map must be obtained from The Brolga flocking areas map must be obtained from <https://www.environment.vic.gov.au/home/managing-impacts-of-renewable-energy-on-environment>. The map may be updated from time to time if new flocking areas are identified.



#### LEGEND

##### Area of interest:



##### Flocking area buffers:

- |              |                           |                               |                 |
|--------------|---------------------------|-------------------------------|-----------------|
| 1 Penhurst   | 4 Lake Bolac              | 7 Streatham                   | 9 Edenhope      |
| 2 Dundonnell | 5 Strathdownie            | (Blue/Pink/Salt Lake Complex) | 10 Cressy       |
| 3 Darlington | 6 Streatham (Lake Wongan) | 8 Willaura                    | 11 Dingee-Corop |

Figure 2: The Brolga flocking areas map

### Due diligence requirements for unmapped Brolga flocking areas

Proponents are required to undertake due diligence to ensure there are no unmapped flocking areas within (wholly or in part) the assessment area. If a flocking area is identified, it must be mapped and treated as a Brolga flocking area.

For flocking areas in the Brolga flocking areas map where no Brolga GPS data was available, a 5km buffer was applied to mapped wetlands that met all three below criteria:

- two or more records of counts of 10 or more Brolgas
- records sourced from two or more consecutive Brolga flocking seasons (December to June), and
- records from more than one month.

A new Brolga flocking area (not mapped in 'Brolga flocking areas map') must meet the above criteria to be treated as a Brolga flocking area and buffering requirements will apply [see **section 4.1** of the Brolga guidance].

DEECA can assist with verification of unmapped flocking areas.

### Identifying Brolga Breeding Wetlands and Potential Breeding Wetlands

DEECA has prepared the Brolga Breeding Habitat Suitability Model (Figure 3), which is available at <https://www.environment.vic.gov.au/home/managing-impacts-of-renewable-energy-on-environment>.

The Brolga Breeding Habitat Suitability Model extrapolates the remotely-sensed environmental characteristics of wetlands where Brolgas are known to breed to the wider landscape to predict the locations of suitable, high-quality Brolga breeding habitat in Victoria and includes known breeding wetlands<sup>9</sup>. The model should be used as the starting point to identify which wetlands require assessment for the purpose of this guidance. Further site surveys and assessment will be required to confirm if wetlands identified in the model are Brolga Breeding Wetlands or Potential Breeding Wetlands.

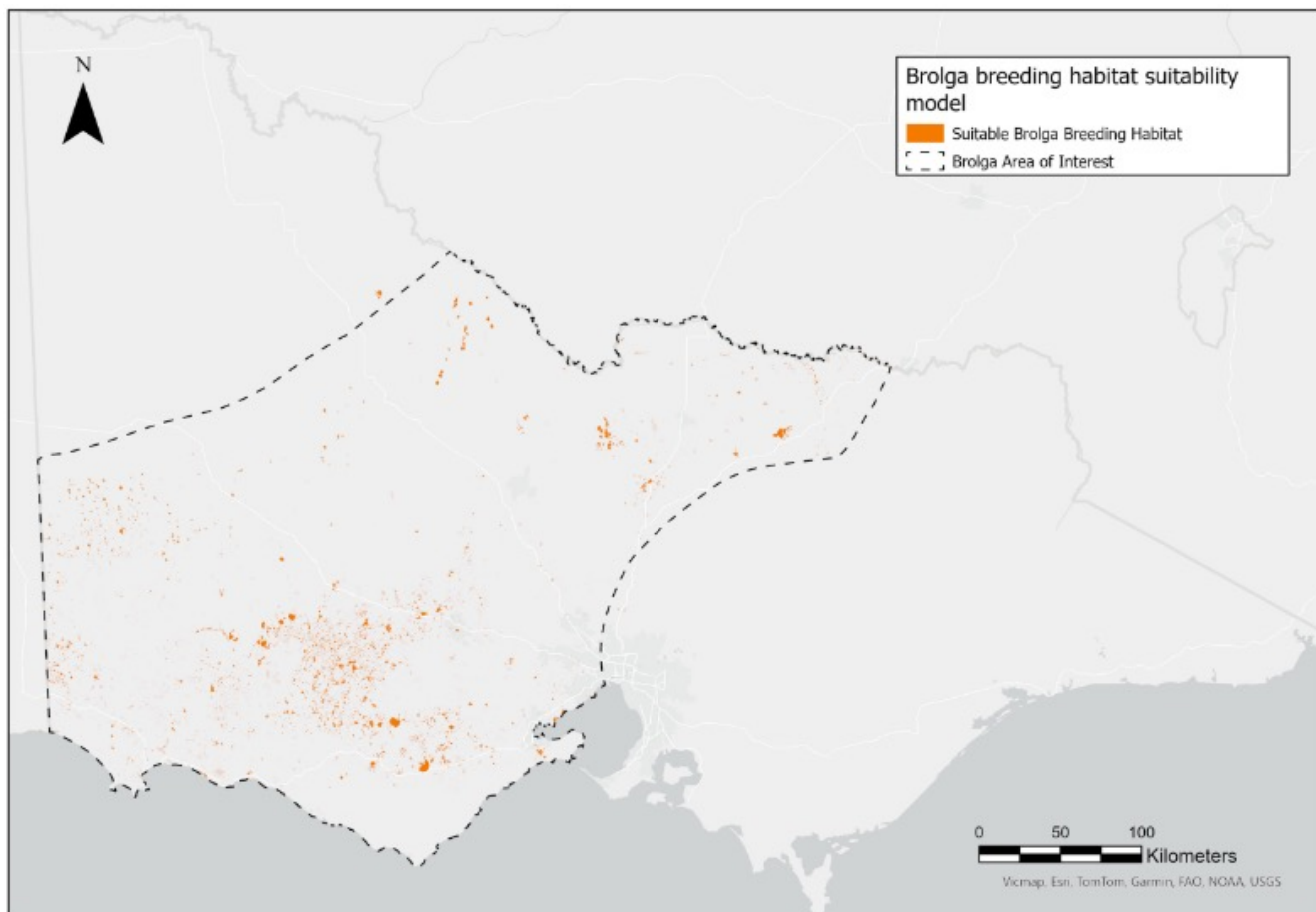


Figure 3: The Brolga Breeding Habitat Suitability Model

<sup>9</sup> <https://engage.vic.gov.au/download/document/38641>

### Assessment for Brolga Breeding Wetlands

For the purposes of this guidance, the definition of a **Brolga Breeding Wetland** is:

*The nest of a Brolga breeding pair and the perimeter of the surrounding wetland. A breeding wetland also includes wetlands with previous verified records of Brolga breeding nests from the Victorian Biodiversity Atlas (VBA) and Birdlife in the last 20 years.*

For the purposes of this guidance, the definition of a **Potential Breeding Wetland** is a wetland that meets all of the following criteria:

**Table 9: Criteria to define a Potential Breeding Wetland**

Criteria	Rationale
Does not have an associated Brolga breeding record in the past 20 years.	A wetland mapped in the Brolga Breeding Habitat Suitability Model with a known breeding record in the past 20 years is considered a Brolga Breeding Wetland.
Meets the inundation requirements of 120 days through breeding season in any year in the ten-year period preceding the commencement of assessment.	120 days of inundation during breeding season allows for nest building and incubation of Brolga chicks becoming mobile where the breeding pair may walk them to other wetlands.
Wetland with sufficient emergent vegetation, within and surrounding wetland, to allow for nest building.	Important for both nest building and protecting Brolga chicks from predators. Sufficient emergent vegetation includes: <ul style="list-style-type: none"> <li>• vegetation not over one metre in height</li> <li>• presence of low wetlands plants that respond to shallow flooding that allow for food, nest construction and cover</li> <li>• trees and taller vegetation may be present but are generally interspersed with vegetation of lower height and areas of open water.</li> </ul>

### Assessment process

1. Identify all wetlands mapped in the assessment area from the Brolga Breeding Habitat Suitability Model. Due diligence is required to identify any other wetlands in the assessment area not shown in the model.
2. Of those wetlands, identify all Brolga Breeding Wetlands through a combination of desktop data review, field studies, hydrological analysis and consultation with local residents, representatives of local environmental agencies and council and community environment groups.
3. Field surveys must be conducted from July through the breeding season. This is to ensure that the Brolga Breeding Wetland can be identified for the purpose of applying the Breeding Wetland Buffer.
4. The following must be identified through this assessment:
  - If there are any breeding pairs within the assessment area, and how many.
  - For each breeding pair, the Brolga Breeding Wetland.
    - The Brolga Breeding Wetland is identifiable by conducting surveys from July through the breeding season, at least once per month for each wetland within the assessment area across two breeding seasons. This early commencement of field surveys will enable visual identification of either nest building or the Brolga pair with a chick in a nesting wetland prior to chick walking (or both).
    - All efforts must be made to identify the Brolga Breeding Wetland, as this is the wetland that a Breeding Wetland Buffer must start from. If the Brolga Breeding Wetland cannot be identified, explanation as to why must be provided in the assessment report. The buffer will start from a different location, as per the buffering assessment below.

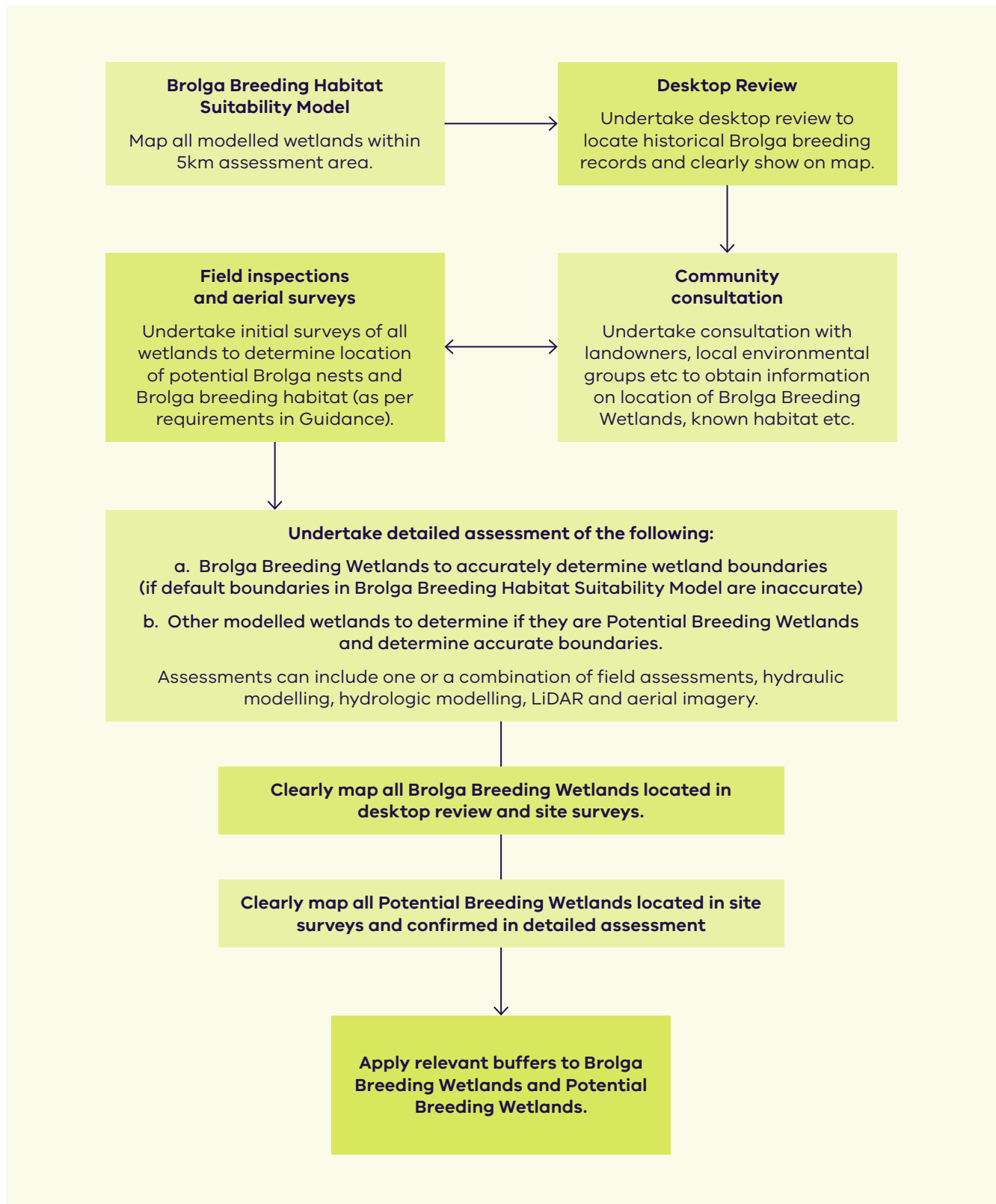


Figure 4: Steps in the process to identify, assess and buffer Brolga Breeding Wetlands and Potential Breeding Wetlands

## 4. Applying the mitigation hierarchy to manage impacts on Brolga

### 4.1 Measures to avoid impacts – Flocking Areas

The following measures apply to any wind energy facility to avoid impacts on the Victorian Brolga population:

- Any turbine, building or other structure or thing used in or in connection with the generation of electricity by wind force and anemometers is prohibited within a Brolga flocking area. This includes any electricity transmission lines connecting the wind energy facility to the electricity network.

To avoid impacts on Brolga flocking, the following assessments are required:

- Assess whether any part of the use and development is within an area mapped as a Brolga flocking area on the flocking areas map. Do this by overlaying the proposed wind energy facility site over the Brolga flocking areas map.
- Undertake due diligence to ensure there are no unmapped Brolga flocking areas within (wholly or in part) the assessment area [see section 3.3 of the Brolga guidance].
  - If a flocking area is identified, map the flocking area. The area will be treated as a Brolga flocking area and a default buffer area of 5kms for these areas is recommended. This is considered to protect most of the night and day roost wetlands and surrounding non-wetland foraging areas, likely to be used by Brolgas in these areas.
  - A proponent may propose a different buffer area, which must be supported by evidence that demonstrates how the proposed buffer will manage impacts to the night and day roost wetlands and surrounding non-wetland foraging areas. DEECA must be consulted on any proposed buffer distance that differs from the default, and confirm they are satisfied that the proposed buffer will provide adequate protection for the unmapped flocking area.
- Use and development for a proposed wind energy facility is prohibited within any part of a Brolga flocking area. Adjustment to the proposed use and development will be required to avoid the Brolga flocking area(s).

### 4.2 Measures to minimise impacts

The following measures apply to any wind energy facility to minimise impacts on the Victorian Brolga population:

- The Breeding Wetland Buffer must be applied to all wetlands that are Brolga Breeding Wetlands.
- The Potential Breeding Wetland Buffer must be applied to all Potential Breeding Wetlands, unless an alternative mitigation and compensation arrangement is agreed to the satisfaction of DEECA [see sections 4.3 and 4.4 of the Brolga guidance].
- The use and development of land for a wind energy facility or an electricity transmission line (directly associated with a wind energy facility or to connect it to the national electricity network) is prohibited within a Breeding Wetland Buffer or a Potential Breeding Wetland Buffer unless the following conditions are met:
  - The use or development is for underground cabling or an underground electricity transmission line (directly associated with a wind energy facility or to connect a wind energy facility to the national electricity network) and measures to minimise disturbance and habitat loss impacts for Brolga from construction activity are agreed to the satisfaction of DEECA and included within an approved Environmental Management Plan or Construction Environmental Management Plan for the wind energy facility.
  - The use or development of land is to maintain or upgrade an existing all-conditions internal access track or to construct a new all-conditions internal access track, provided the track:
    - meets any engineering standards or requirements imposed as part of planning approval; and
    - measures to minimise disturbance and habitat loss impacts for Brolga from construction activity, especially for Brolga Breeding Wetlands, are agreed to the satisfaction of DEECA and included within an approved Environmental Management Plan or Construction Environmental Management Plan for the wind energy facility.



Protection of Brolga Breeding Wetlands is very important to maximise fledging success. To manage risks that Brolga may need to find new breeding territories and new juvenile pairs seeking breeding territory, it is proposed to also protect other Potential Breeding Wetlands that have suitable breeding habitat. The Breeding Wetland Buffers are designed to protect three key habitat elements related to pre-fledging chick and adult breeding pair movements:

- The wetlands used for the nest, egg incubation and night roosting.
- The non-wetland areas around breeding wetlands used for foraging.
- The non-wetland areas used as movement corridors between nesting and night roost wetlands.

#### **Application of Breeding Wetland Buffers**

##### **Buffer for a Brolga Breeding Wetland with no other Brolga Breeding Wetlands or Potential Breeding Wetlands within 2km home range area**

1. A 900 metre (600 metre foraging buffer plus 300 metre disturbance buffer) buffer is required around a Brolga Breeding Wetland. The buffer must be applied from the boundary of the wetland.
2. The default boundary of each wetland must be based on the wetland boundary in the Brolga Breeding Habitat Suitability Model. However, hydrological analysis can be used to ground truth the model and demonstrate if the actual extent and/or boundary is different to what is included in the model (see further detail below).
3. Repeat for each Brolga Breeding Wetland identified within the 5km assessment area of the wind energy facility.

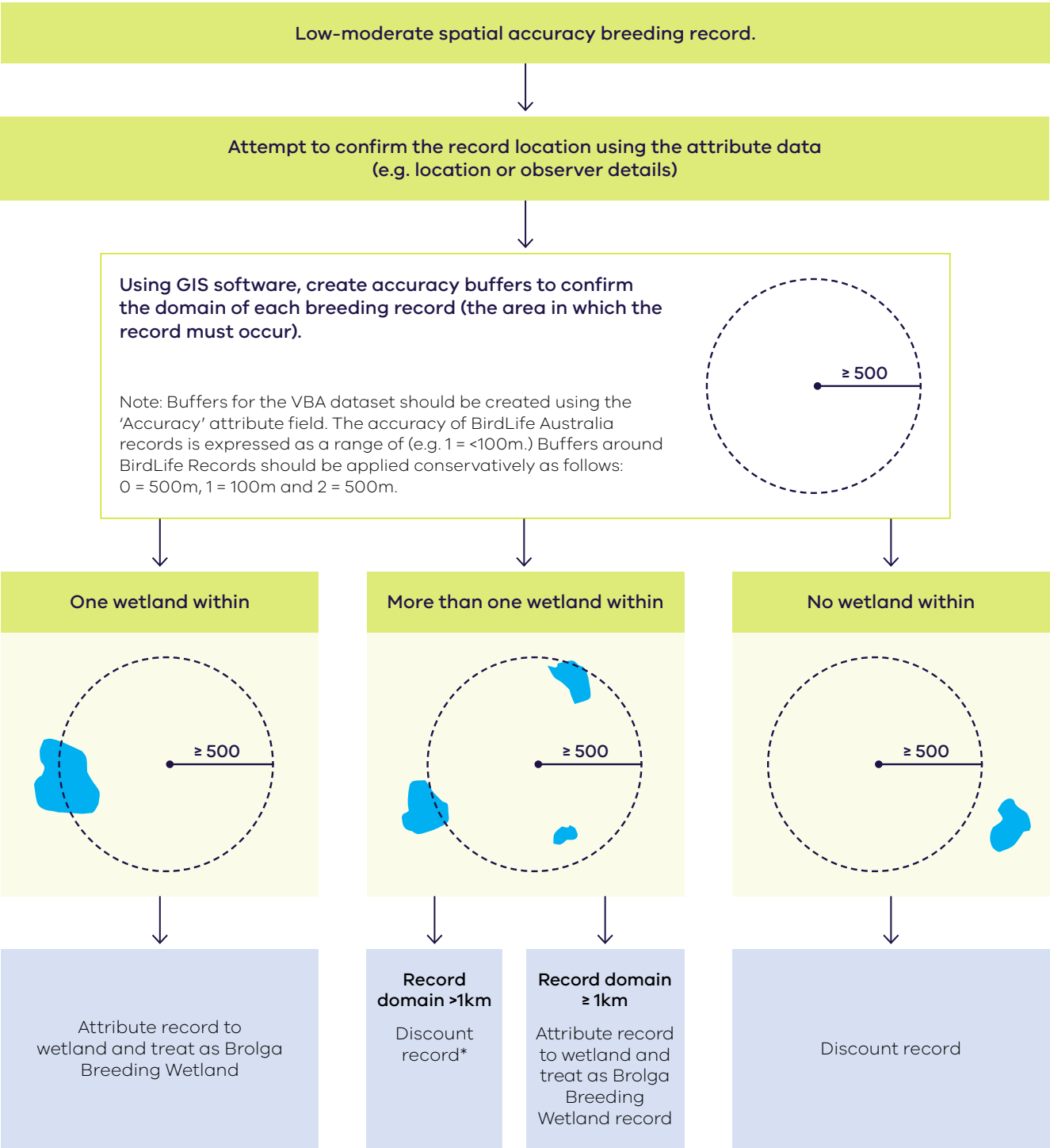
##### **Buffer for a Brolga Breeding Wetland with other Brolga Breeding Wetlands and/or Potential Breeding Wetlands within 2km home range area**

1. A 900 metre (600 metre foraging buffer plus 300 metre disturbance buffer) buffer is required around a Brolga Breeding Wetland. The buffer must be applied from the boundary of the wetland.
2. A buffer must also be applied from the Brolga Breeding Wetland to all other surrounding Brolga Breeding Wetlands and/or Potential Breeding Wetlands within 2km of the subject Brolga Breeding Wetland. This captures the home range of the Brolga. The areas between these wetlands must be buffered to protect movement corridors.
3. Apply the below steps to the subject Brolga Breeding Wetland:
  - 3.1 From the boundary of the Brolga Breeding Wetland, identify and map all surrounding Brolga Breeding Wetlands and Potential Breeding Wetlands within the 2km home range area around the subject wetland.
  - 3.2 The default boundary of each wetland must be based on the wetland boundary in the Brolga Breeding Habitat Suitability Model. However, hydrological analysis can be used to ground truth the model and demonstrate if the actual extent and/or boundary is different to what is included in the model (see further detail below).
  - 3.3 Apply a 900 metre buffer to each Brolga Breeding Wetland and Potential Breeding Wetland, the buffer must be applied from the boundary of the wetlands.
  - 3.4 Apply a movement corridor between all wetlands within 2km of the Brolga Breeding Wetland (measured from the widest extent of each wetland via straight lines).
  - 3.5 The resulting buffer is the Breeding Wetland Buffer for the Brolga Breeding Wetland.
4. Repeat for each Brolga Breeding Wetland identified within the 5km assessment area of the wind energy facility.

Wetlands do not require the Breeding Wetland Buffer if they meet any one of the below criteria:

**Table 10: Criteria to define wetlands that do not need the Breeding Wetland Buffer**

Criteria	Evidence requirements
A wetland with a historical breeding record older than 20 years.	The breeding record from the VBA or Birddata and disregarded wetland clearly shown and labelled on a map.
A wetland with a low accuracy breeding record discounted as per the protocol for managing such records.	Details of process undertaken to manage low accuracy breeding record/s as outlined in the Protocol in Figure 5 below.
The wetland is covered by a hardened, man-made surface (e.g. a road) and is therefore no longer capable of holding water or functioning as a wetland.	Date-stamped aerial or on-ground photographs with GPS coordinates, or contour maps with GPS coordinates, are required. The evidence must show that it is obvious that the mapped area has been incorrectly identified as a mapped wetland or the wetland has been permanently drained. Evidence requirements include, but are not limited to:
A modelled wetland has been incorrectly identified as a wetland, and the mapped area is not capable of functioning as a wetland.	<ul style="list-style-type: none"> <li>contours show that the location is a hill rather than a depression and therefore the mapped area is not capable holding water</li> <li>on-ground photographs or satellite imagery clearly show a drainage channel impacting the wetland</li> <li>satellite imagery from previous breeding seasons show that no water was held in the wetland</li> <li>photographs clearly show the wetland has been planted with trees</li> <li>detailed hydrological modelling clearly shows that the wetland has been permanently drained and cannot hold water.</li> </ul>
The wetland has been permanently drained.	



\* Records may be discounted if adequate evidence is provided to indicate the accuracy tribute is incorrect (e.g. confirmation of inaccuracy from observer or source literature report). Discounted records must be retained in Assessment Reports as unvalidated database records.

Figure 5: Protocol for managing low-moderate accuracy breeding records

### Application of Potential Breeding Wetland Buffers

1. A 300 metre buffer must be applied to each Potential Breeding Wetland identified in the Brolga Breeding Habitat Suitability Model within the 5km assessment area of the wind energy facility, but which is outside the 2km home range of a Brolga Breeding Wetland. The buffer must be applied from the boundary of the wetland.
2. The default boundary of each wetland must be based on the wetland boundary in the Brolga Breeding Habitat Suitability Model. However, hydrological analysis can be used to ground truth the model and demonstrate if the actual extent and/or boundary is different to what is included in the model (see further detail below).
3. Movement corridors are not required for Potential Breeding Wetland Buffers.

The following wetlands do not require a Potential Breeding Wetland Buffer:

**Table 11: Criteria to define wetlands that do not require the Potential Breeding Wetland Buffer**

Criteria	Evidence Requirements
A wetland that does not meet the required inundation requirements to allow for Brolga fledging.	Evidence that the wetland does not meet the inundation requirements of 120 days through breeding season in any year in the ten-year period preceding the commencement of assessment.
Wetlands less than 0.10ha in size.	Disregarded wetland/s clearly shown and labelled on map.
Permanent saline swamps, temporary saline swamps, saline marshes and meadows, estuaries, high country peatlands and intertidal flats and farm dams that do not have a known breeding record.	Disregarded wetland/s clearly shown and labelled on map.
Wetlands that are now covered by a hardened, man-made surface (e.g. a road) and are no longer capable of holding water or functioning as a wetland or have been permanently drained.	Date-stamped aerial or on-ground photographs with GPS coordinates, or contour maps with GPS coordinates, are required. The evidence must show that it is obvious that the mapped area has been incorrectly identified as a mapped wetland or the wetland has been permanently drained. Evidence requirements include, but are not limited to: <ul style="list-style-type: none"> <li>• contours show that the location is a hill rather than a depression and therefore the mapped area is not capable holding water</li> <li>• on-ground photographs or satellite imagery clearly show a drainage channel impacting the wetland</li> <li>• satellite imagery from previous breeding seasons show that no water was held in the wetland</li> <li>• photographs clearly show the wetland has been planted with trees</li> <li>• detailed hydrological modelling clearly shows that the wetland has been permanently drained and cannot hold water.</li> </ul>
A mapped wetland that has been incorrectly identified as a wetland and the mapped area is not capable of functioning as a wetland.	

## Determining the boundaries of Brolga Breeding Wetlands and Potential Breeding Wetlands

1. As a default, the extent of a wetland is based on wetland boundary mapped in the Brolga Breeding Habitat Suitability Model.
2. If site surveys or hydrological analysis indicate that the modelled wetland boundary is incorrect, the wetland boundary can be realigned. The wetland boundary must be measured from the wetland basin at its greatest extent during breeding season when inundated for at least 120 days in any year in the ten-year period preceding the commencement of the assessment.
3. Assessment requirements to amend a wetland boundary include, but are not limited to the following:
  - Recorded rainfall data over a ten-year period
  - Satellite imagery
  - High-resolution topographic mapping (LIDAR)
  - Hydraulic and water balance modelling.

### 4.3 Measures to mitigate impacts

Other mitigation measures can be implemented to reduce the impacts of the proposed wind energy facility on the Brolga.

**Table 12: Measures to mitigate impacts on Brolga**

Mitigation measure	Description
<b>Marking electricity transmission lines</b>	Collision with electricity transmission lines is an important source of anthropogenic mortality for many crane species and is a recognised cause of Brolga mortality. Marking electricity transmission lines to reduce collision mortality has been demonstrated to markedly reduce collision risk for other species of cranes. A range of bird flight diverter products are commercially available.
<b>Land management actions</b>	<p><b>Water Regime Management</b> Implementing water regime management to maintain the health and accessibility of Brolga Breeding Wetlands and Potential Breeding Wetlands. This ensures that critical wetland habitats are preserved and available for Brolga, promoting breeding success.</p> <p><b>Stock Control and Fencing</b> Managing livestock and preventing overgrazing around Brolga Breeding Wetlands and Potential Breeding Wetlands through effective stock control can protect these sensitive areas from degradation, which is crucial for Brolga habitat preservation.</p> <p><b>Weed Management</b> Implementing a weed management plan to control invasive plant species around Brolga Breeding Wetlands and Potential Breeding Wetlands will help maintain the integrity of the wetlands and the natural vegetation Brolga rely on for food and shelter.</p>



#### 4.4 Compensatory measures

Section 6.3 of the Handbook sets out requirements for compensation of residual impacts on threatened bird and bat species from a renewable energy facility. In addition to those requirements, Brolga compensation must provide protection and enhancement of Brolga Breeding Wetlands and Potential Breeding Wetlands and must be combined with active and on-going management.

If the avoid, minimise and mitigate measures outlined above are applied to Brolga Breeding Wetlands and Potential Breeding Wetlands, there should be no or minimal residual risk to the Victorian Brolga population from a wind energy facility.

However, compensation can be required if project siting does not allow for the application of the buffer to a Potential Breeding Wetland that is within the 5km assessment area, but outside the 2km home range of a Brolga Breeding Wetland. Compensatory measures must be accompanied by the mitigation measures outlined in Table 12, Section 4.3 of this Brolga guidance and must be commensurate with the risk of not protecting a wetland that a Brolga breeding pair may use in the future.

The nature and extent of compensatory measures is determined by:

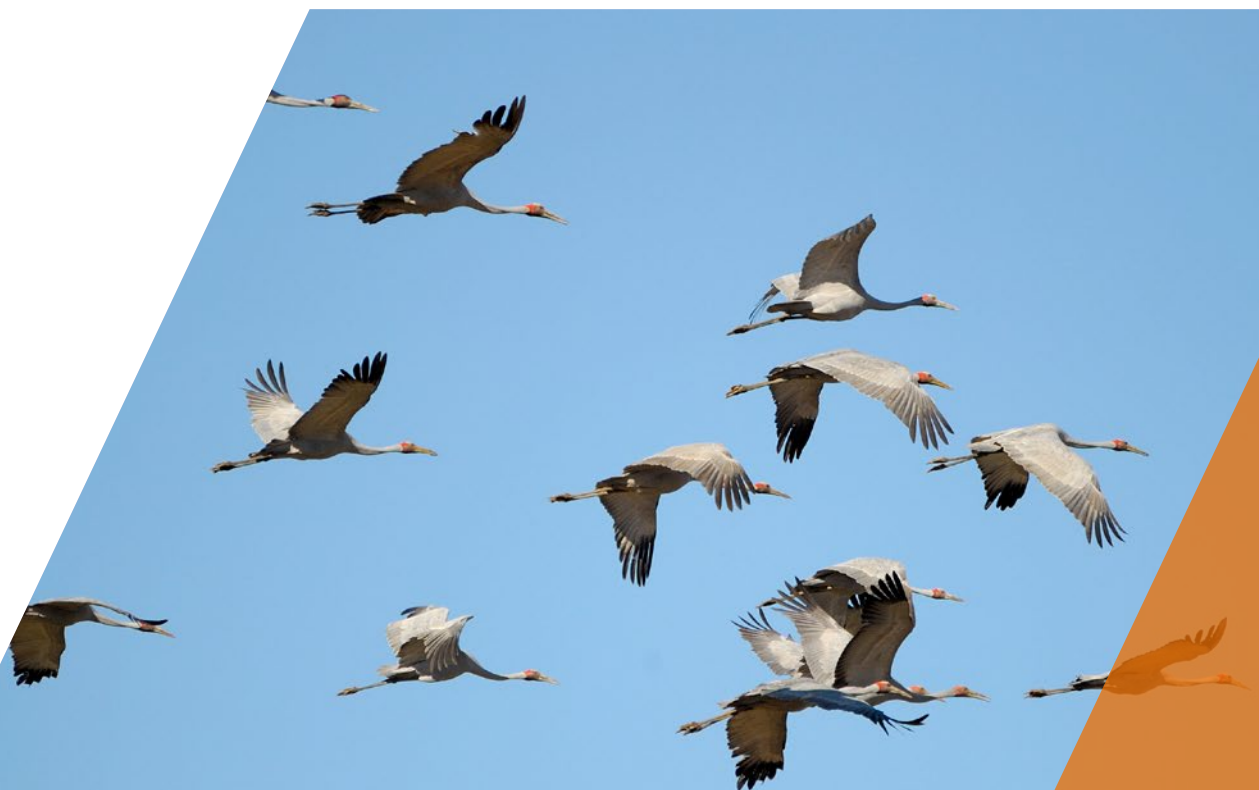
- the number of Potential Breeding Wetlands not buffered by a 300m buffer
- the size of the wetlands not buffered
- proximity and connectivity of wetlands to other shallow vegetated wetlands.

The purpose of Brolga compensation is to protect and enhance habitat to enhance breeding success at breeding sites. Maintaining water levels and reducing disturbance are likely to be the most effective ways of enhancing breeding success. Measures may include:

- restoration of the natural flooding regime of wetlands by closing drains
- increasing inundation frequency of Brolga Breeding Wetlands through artificial flooding
- creating new potential breeding habitat by damming or modifying existing wetlands or dams
- management of wetland vegetation condition through controlled grazing (or stock removal) to improve suitability as a breeding site
- addition of nesting material to Potential Breeding Wetlands to facilitate nest building, or
- fox control at breeding sites.

All measures above must be accompanied by active management to reduce predation during breeding, such as fox control measures.

Further compensation actions may be required if post-construction monitoring determines mortalities and/or significant disturbance to Brolga as outlined in any approved BAM Plan.



## 4.5 Information requirements

The information that must accompany a planning permit application where this guidance applies is:

Table 13: Information requirements checklist for applications

Information requirements and checklist	Format
<b>A map that shows:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> The <b>assessment area</b> for the proposal</li> <li><input type="checkbox"/> All Brolga breeding records within the <b>assessment area</b></li> <li><input type="checkbox"/> Location of any <b>Brolga Flocking Areas</b> within the <b>assessment area</b></li> <li><input type="checkbox"/> Modelled wetlands from the <b>Brolga Breeding Habitat Suitability Model</b></li> <li><input type="checkbox"/> Other <b>wetlands</b> identified through the assessment process</li> <li><input type="checkbox"/> A legend and a scale bar</li> </ul>	A PDF of the map and GIS spatial files.
<b>Evidence requirements for:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Any disregarded <b>Brolga breeding records</b></li> <li><input type="checkbox"/> Any disregarded <b>wetlands</b> from the <b>Brolga Breeding Habitat Suitability Model</b></li> <li><input type="checkbox"/> Any <b>wetland boundary realignments</b> from the <b>Brolga Breeding Habitat Suitability Model</b></li> </ul>	Short report and JPEG images.
<b>If Breeding Wetland Buffers and/or Potential Breeding Wetland Buffers apply, the assessment area map that showing:</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Location of all proposed infrastructure</li> <li><input type="checkbox"/> <b>Breeding Wetland Buffers</b></li> <li><input type="checkbox"/> <b>Potential Breeding Wetland Buffers</b></li> </ul>	A PDF of the map and GIS spatial files

# Appendix 3: Species Specific Guidance for Onshore Wind Energy Facilities – Bat Species of Concern

This guidance provides supplementary information on how to assess and manage impacts from wind energy facilities on bat species listed on the Species of Concern List [see **Appendix 1**].

## 1. Bat Species of Concern

DEECA has assessed five bat species for inclusion on the Species of Concern list:

- Southern Bent-wing Bat (*Miniopterus orianae bassanii*)
- Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*)
- South-eastern Long-eared Bat (*Nyctophilus corbeni*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*).

These bats fall into two high level categories of bats referred to in this guidance:

- Flying-foxes (Grey-headed Flying-fox)
- Echolocating insectivorous bats<sup>10</sup> (Southern Bent-wing Bat, Eastern Bent-wing Bat, South-eastern Long-eared Bat, and Yellow-bellied Sheathtail Bat).

These categories have different ecology and habitat requirements, as well as appropriate survey methods. For this reason, where a measure or guidance is only relevant for one category of bats, this will be indicated clearly. When it applies to all categories, the general term ‘bat’ is used.

## 2. Risk to bats from the construction and operation of wind energy facilities

Bats can be impacted by the development of wind energy facilities in a number of different ways, including:

- Habitat loss through clearance
- Disturbance
- Collision with wind turbines
- Displacement and barrier effects
- Mortality through electrocution on electricity transmission lines.

There remains a level of uncertainty regarding the precise level of risk these impacts pose at a species population level. However, species such as the Southern Bent-wing Bat and Grey-headed Flying-fox have been recorded as fatalities during post-construction mortality monitoring surveys at Victorian wind energy facilities. Research from other jurisdictions also shows evidence of changes to bat ranges and habitat use near operational wind energy facilities, in the form of either attraction to turbines, or avoidance and displacement from the area.

### 2.1 Important ecological features for bats, to be considered as part of site and context analysis

#### Roosting sites for Bent-wing Bats

Bent-wing Bat<sup>11</sup> species frequently congregate in large numbers at specific roosting sites. Roosts provide shelter, security and a safe area for juveniles to develop. For this reason, there is often a concentration of bats of all ages in and around roosting locations and radiating out to the surrounding landscape. Bent-wing Bats will also regularly fly between roosts and foraging areas and frequently move between roosting sites.

Roost sites vary in size and significance, with key sites like maternity caves used by larger numbers of Bent-wing Bats. In addition, there are key non-breeding sites which are regularly used by large proportions of the population.

The intent of this guidance is to focus on key roosting sites which play a critical part in the resilience and persistence of Bent-wing Bat species. ‘Key roosting sites’ for Bent-wing Bats are defined based on the following criteria:

- For Southern Bent-wing Bats, key roosting sites are defined as maternity roosts and non-breeding roosts that regularly contain high hundreds or thousands of bats as verified by DEECA.
- For Eastern Bent-wing Bats, key roosting sites are defined as maternity roosts and non-breeding roosts that regularly contain hundreds or thousands of bats as verified by DEECA.

<sup>10</sup> Echolocation is the ability to use sound waves to determine the location of objects, in this case their insect prey and to avoid obstacles.

<sup>11</sup> This includes the Southern Bent-wing Bat (*Miniopterus orianae bassanii*) and the Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*)

### Risks of locating onshore wind energy facilities close to key roosting sites for Bent-wing Bats

The location of the key roosting site itself, as well as the broader foraging area around the roost which supports the population, are key risk factors for a potential wind energy facility. The concentration of Bent-wing Bat populations, importance for successful breeding, and increased flight and movement activity in the area mean that locating an onshore wind energy facility close to a key roosting site can have potentially significant impacts, including:

- Bent-wing Bats colliding with operating turbines
- both the construction and operation of a wind energy facility could cause displacement of Bent-wing Bats previously using the area
- the wind energy facility may create a barrier between key roosting sites and essential foraging areas
- the clearing of vegetation as part of constructing the wind energy facility and supporting infrastructure could reduce foraging resources.

The critical importance of key roosting sites to species persistence for Bent-wing Bats means that such impacts could present a significant risk to a high proportion of the population. Therefore, any wind energy facilities proposed within flight distance of a key roosting site may present a heightened risk to the species and should be addressed as part of assessing the impacts of the proposed project.

The risk of these impacts likely increases the closer to the key roosting site the wind energy facility is located, noting there is currently insufficiently robust data and/or information to accurately differentiate the risk profile. However, data shows that Southern and Eastern Bent-wing Bats fly up to 85 km or more from a roost. A distance of 50km reflects an approximate mean foraging distance of Southern Bent-wing Bats.

For this reason, any wind energy facility proposed to be located within 50km of an identified key roosting site for Bent-wing Bats should assume the following:

- the key roosting site is an important ecological feature for the purposes of identifying risk factors under Criteria 3 in **Section 6.1** of the Handbook; and
- there is a heightened risk of collision, displacement, disturbance and barrier effects that the proponent will need to consider in impact assessments and manage through the application of measures under the mitigation hierarchy.

### Identifying roosting sites for Bent-wing Bats

Many roosts are located on private property and therefore landholder information and privacy must be protected<sup>12</sup>. DEECA can provide approximate locations of all known key roosting sites for Southern Bent-wing Bat and Eastern Bent-wing Bat to proponents upon request (precise locations are not provided due to privacy and disturbance risks).

Such information will be sufficient for proponents to identify if their proposed development site for a wind energy facility is within 50kms of a key roosting site and take appropriate action to either avoid the area where practicable, or plan for necessary measures to assess potential impacts and identify measures under the mitigation hierarchy that will address those impacts.

Should additional unknown roosts be located through assessment processes or unrelated searches or research, they may subsequently be added to the list of 'key roosting sites' if they are determined by DEECA to meet the criteria outlined above.

## 2.2 Assessing the occurrence, or likely occurrence, of bat species on the proposed site and surrounding area

This guidance outlines options for carrying out a range of monitoring and survey techniques to inform the assessment of the proposed site and surrounding area to identify the occurrence or likely occurrence and activity of bat species.

### Pre-construction surveys

The aim of pre-construction bat activity surveys is to identify key habitat features present on the site or in the surrounding area which are known to be associated with increased levels of bat activity. Pre-construction surveys of the site and surrounding area can be used to test the accuracy of any desk-top assessment and identify the presence of bat Species of Concern. Pre-construction surveys and assessments can also be used to inform risk assessments, site design and turbine location.

The following guidance is intended to assist proponents by setting out a methodology for conducting pre-construction bat surveys in a thorough and effective manner. Proponents should be aware that the characteristics of bat species can differ significantly and different methods are required for different species.

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<sup>12</sup> For the same reasons of privacy, specific locations of roost should not be included in any reports, documents or other materials that may become public.

### Acoustic activity surveys for echolocating bats

Acoustic surveys using high frequency bat detectors are commonly used to survey for the presence and relative activity of echolocating insectivorous bats. This section sets out known and effective methods for detecting activity of the following Species of Concern:

- Southern Bent-wing Bat
- Eastern Bent-wing Bat
- Yellow-bellied Sheathtail Bat.

It is not currently possible to reliably distinguish the presence of the South-eastern Long-eared Bat using acoustic call identification, so acoustic surveys are not recommended for this species. If surveys for this species are needed at a site, trapping surveys would be required using harp traps or mist nets in more open areas. Proponents should consult with DEECA before undertaking these approaches. DEECA is working on developing methods to distinguish the echolocation calls of this species and advice will be updated as more appropriate methods become available.

### Monitoring period

Pre-construction surveys should be used to develop an understanding of local bat activity and the species that may be present at or around the site. This includes both relative activity levels across the

site and seasonal variability in activity. This can then be used to inform risk assessments and guide the application of measures under the mitigation hierarchy, such as micro-siting decisions to avoid or minimise predicted impacts or appropriate mitigation approaches to reduce collision risk.

The length of monitoring necessary to achieve this understanding will vary depending on the characteristics of the site and knowledge of the surrounding area.

For this reason, there is no prescribed length for how long a pre-construction monitoring period should be. However, in preparing an application, proponents should clearly set out their monitoring period and describe how monitoring data and any existing information for the site can support a robust risk assessment. This could include providing evidence from scientific literature or existing data that supports how the proposed approach will deliver a clear understanding of bat activity on the site and in the surrounding area and which addresses any uncertainty.

Some examples of monitoring periods are outlined below. The length of monitoring adopted should be commensurate with the level of risk posed by the proposed site. However, proponents may choose alternative approaches based on the specifics of a project.

**Table 14: Recommended pre-construction monitoring periods**

Potential monitoring period	Recommended application
24 months including seasonal sampling	Where little is known about bat activity at a site, or where there may be heightened risk of impacts associated with the site, monitoring over a 24-month period with sampling in each season using the techniques set out in this guidance may be appropriate. This should capture interannual and seasonal variation. Proponents should consider this option if it is reasonably believed a bat Species of Concern is likely to be present, based on proximity to known roosting sites, modelled ranges, habitat features or other relevant information.
24 months sampling during highest activity and risk periods (November to April)	Where existing data or factors indicate risk may be reduced, an alternative is to monitor during the period from November to April over 24 months. This corresponds to periods of high levels of activity (including the breeding season) and the highest bat mortality risk at Victorian wind energy facilities. Monitoring over two seasons will allow some interannual variation to be captured. Although there is some risk that bat activity outside of this period may be more significant than average due to unforeseen local factors, this approach should still provide a good understanding of bat activity during the period shown.
12 months period including seasonal sampling	Sampling during a 12-month period may not capture interannual variation or events occurring on an annual or longer frequency that could impact bat populations, for example droughts or wetter than average seasons. However, seasonal monitoring over a 12-month period may still provide sufficient understanding of the risks if complemented by other relevant data sources.
Sampling during highest risk months of a 12 month period (November to April)	Monitoring from November to April inclusive over a single year is the shortest monitoring period acceptable and should only be used by proponents where they can demonstrate robust information and data gathered from alternative sources. Nonetheless, this approach should capture the peak period of bat activity in Victoria.

Shorter monitoring periods are associated with greater risk of missing critical information and/or failing to capture bat activity levels accurately. These limitations should be taken into account when interpreting data during the assessment and approval process.

### Considerations for undertaking acoustic activity surveys

Acoustic surveys can record large quantities of information about bat activity without having to capture bats or otherwise cause disturbance to a species. For this reason, it is an internationally recognised approach that is used across many jurisdictions.

The method requires a high level of expertise and has several limitations and/or issues that need to be considered when undertaking and analysing data from acoustic surveys to ensure robust risk assessments:

- Acoustic bat detector surveys can identify species and relative activity across given time periods. However, these surveys cannot determine absolute abundance of bats as it cannot be determined how many individuals produced the calls. Data from acoustic surveys should be used for comparative purposes, for example to investigate relative changes over time or between locations, but should not be used to estimate the number of individuals at risk.
- As the detector microphones are often omnidirectional the direction of flight cannot be determined from these datasets. Data should not be used to infer flight direction.
- Where calls cannot be definitely identified and exclusively attributed to a single species, calls of species with overlapping call parameters are often grouped together into 'species complexes' for analysis. For example, the Southern Bent-wing Bat is often put into a species complex with up to three other species. Basing counts or analysis only on calls considered 'definite' risks underestimating the true number of calls and therefore local activity of a species. Therefore, where a species complex includes a bat Species of Concern and the area is located within the distribution of the Species of Concern, a precautionary approach should be applied.
  - Where any calls recorded in that complex could represent the bat Species of Concern, it should be assumed that some of these calls could be the Species of Concern and a proportion of the species complex calls should be attributed to that Species of Concern.

- This proportion is to be determined based on the relative proportion of definite call identifications attributed to the Species of Concern for that site and monitoring period. For example, if a species complex includes four possible bat species, and the total definitely identified calls for those four species for that site and period include 25 per cent identified as Southern Bent-wing Bats, then 25 per cent of the calls that could only be identified to the species complex level should be assumed to be Southern Bent-wing Bats.
- Post-construction monitoring in combination with an adaptive management framework can also be used to manage uncertainty related to Species of Concern activity estimates and risk assessments based on species complexes.

- Results from acoustic bat surveys only record information within the airspace in relative proximity to the detectors and activity is susceptible to being masked by wind or other sources of noise, meaning results are likely to under-represent true bat activity. It should not be assumed that survey results represent the maximum level of bat activity.
- Most bat species in Victoria have been detected as mortalities at wind energy facilities, so risk assessments should assume that any bat species detected at ground level has the potential to fly at height and be impacted at rotor swept height.

To ensure efficient and effective assessment and approval processes, proponents should demonstrate in their application documents how these issues have been considered and, where necessary, addressed.

### Acoustic surveys approaches

There are two principal approaches for undertaking acoustic surveys:

- at ground level
- at height, usually done by attaching bat detectors to met-masts or other infrastructure, sometimes at a series of different heights to try to discern information about bat flight height and relative activity at these heights on the site.

Either method, or a combination of the two, is a valid approach. However, to maximise their effectiveness, proponents should consider the following matters when undertaking surveys. Proponents will be expected to demonstrate that they have given due consideration to these matters as part of their application process.



### *Undertaking ground surveys*

Factors which can improve survey accuracy or confidence in ground survey results include:

- Ensuring that sampling points incorporate potential turbine locations and the various habitat types on and adjacent to the site, and that sites are selected specifically for surveying bats, rather than using sites selected for surveying birds.
- Ensuring that anyone deploying bat detectors is trained to place detectors optimally to record passing bats and reduce noise interference.
- Ensuring data from different sites is comparable by making sure settings of all detectors deployed are the same, e.g. signal duration, call frequency triggers. This will limit variability between detectors and improve accuracy in discerning differences between monitored sites.
- Conducting sampling in weather conditions conducive to successfully detecting bats, such as warmer temperatures without rainfall and during low wind conditions.
- Collecting weather data concurrently with bat calls to support data interpretation, as bat activity typically reduces with lower temperatures and higher wind speeds. High wind speeds often result in significant noise recorded in addition to bat calls, which can make it more difficult to identify calls.
- Ensuring that analyses are undertaken by an experienced practitioner familiar with the target species and geographic area variation in call characteristics, will result in more accurate identification of calls and robust data interpretation, due to the high complexity of call analysis.
- Undertaking data collection and analyses in full spectrum where feasible, rather than zero-crossing. Full-spectrum bat detectors record all information about the high frequency sound while zero-crossing reduces sound to single-points based on the strongest frequency of sound at each given point of time. Zero-crossing is more susceptible to missing bat calls due to difficulty in distinguishing calls without detail from harmonics, in the presence of wind or other noise, and when multiple species are calling simultaneously.
- Independent peer-review of call identification for target species, including of calls designated as 'possible ID' or potential species-complex.

### *Undertaking height surveys*

Height surveys monitor part of the rotor swept area (i.e. part of the collision risk zone) which is not monitored by ground surveys, height surveys have limitations that proponents should consider before undertaking them. These limitations include:

- Higher noise to signal ratio due to higher wind and noise interference at height, which reduces the detectability of bat calls.
- Rapid geometric and atmospheric attenuation of high frequency calls means that calls are only discernible in a small airspace. Geometric and atmospheric attenuation is affected by call frequency as well as weather conditions, such as temperature, humidity and air pressure.
- Low replication due to the small number of met masts deployed resulting in a small sample size that limits interpretation and extrapolation of results.

If undertaken, the accuracy of height surveys can be improved through:

- use of measures to reduce the impact of noise on recording, including choice of mounting
- increased sample size and monitored airspace through deployment on multiple met masts
- use of full-spectrum recording format to increase the data available to support identification of calls.

Data from ground and height surveys should not be directly compared in analyses, as the different approaches and limitations would result in a comparison that is not meaningful and may result in inaccurate conclusions.

### *Reporting results*

Where possible the reporting for acoustic bat surveys should include:

- a description of the reference library used in the identification process, noting that locally collected reference calls are required for many species
- the number of detector nights undertaken during the survey
- a description or photograph of each detector site and the surrounding environment, to assist in call analysis and data interpretation (e.g. the calls of a species can vary markedly depending on if the detector is placed in an open or cluttered environment)
- a description of all analysis tools used and decisions made, such as automated processes, filters applied or decision trees, and how calls were defined (e.g. minimum pulses and duration)

- a sample 'time versus frequency' graph of each species identified during the survey, using data from bats recorded and identified during the survey, not examples from other studies
- for species with similar call characteristics, a written description of the characteristics used to distinguish these species
- an indication of the proportion of calls identified, i.e. the total number of calls processed and the percentage of these that were identified
- a description of the quality of the data, including the proportion of noise recorded and any missing data periods
- all the call files from a survey are stored by the consultant and made available if further analysis is required.

In addition, proponents are advised to avoid providing data as pooled averages over the monitoring period. Data provided in this manner is difficult to interpret and may result in a more complex assessment process due to the resulting uncertainty. Representing results as averages or rates could mask periods of high activity through inclusion of periods when detecting bats was unlikely due to poor conditions, high noise levels or equipment malfunction.

Where long periods of sampling have been undertaken however, data can be summarised into weekly or monthly averages where measures of variability such as range and standard deviation are also included, to show the full variation in nightly activity that was recorded.

### Grey-headed Flying-fox surveys

Grey-headed Flying-foxes have different ecology and habitat to echolocating insectivorous bats and so require different survey approaches. The most important input to determining the risk to Grey-headed Flying-foxes is the proximity to roost sites, known as camps.

### Identifying roost/camp locations

Known locations of Grey-headed Flying-fox roosts/camps can be identified based on publicly available data including:

- Victoria's Flying-fox Map: [www.wildlife.vic.gov.au/flying-foxes](http://www.wildlife.vic.gov.au/flying-foxes),
- the National Flying-fox Monitoring viewer: <https://environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf>.

Information on both active and inactive known Grey-headed Flying-fox camps is relevant and should be obtained, as camp usage can be regular but non-continuous, for example seasonal use of a site.

Further understanding of the how flying foxes may utilise the area can be gained by identifying foraging locations and potential flight paths.

### Vegetation surveys for potential foraging locations

Mortality patterns in western Victoria have shown a relationship between Grey-headed Flying-fox mortalities and the presence of favoured food tree species (e.g. planted Sugar Gums) when they are flowering. The presence of these trees near a proposed wind energy facility could attract Grey-headed Flying-foxes into the site.

To identify potential foraging locations, surveys should be undertaken to identify potential foraging resources on or near the site, including planted wind breaks and roadside vegetation, which will inform the likely risk. Relevant tree species include flowering Eucalypts (*Eucalyptus*, *Corymbia* and *Angophora*), *Banksia*, *Callistemon*, *Grevillia*, *Melaleuca* and fruiting species such as *Ficus* (figs) and cultivated fruits.

### Identify potential flight paths

Once potential foraging sites have been identified, these can be used to identify likely flight paths from any of those sites and identified roosting site. Likely flight paths can also be informed by publicly available GPS-tracking data, published research, or information available through consultation with species experts. Where no more precise data exist, it is reasonable to assume flight paths are straight lines or follow obvious landscape features such as rivers.

Where a flight path is likely to intersect with the proposed site of development, proponents should exercise caution and assume the presence of Grey-headed Flying-fox unless compelling data and/or information can be provided to disprove it.

### 3. Application of the mitigation hierarchy to manage impacts on bat Species of Concern

#### 3.1 Measures to avoid or minimise impacts on bat Species of Concern

Key habitat features that are associated with high levels of bat activity include:

- identified flight paths
- areas of vegetation, both native and non-native
- water bodies.

Proponents should consider avoiding areas of the site which support or are in proximity to these habitat features when making decisions regarding micro-siting of individual turbines. Avoiding areas of concentrated bat activity or movement that are associated with the above habitat features will reduce risk of collision mortality.

Acknowledging that avoidance of all features may not be feasible or practical, proponents are encouraged to prioritise avoiding the following features, where practicable:

- Areas of native vegetation. While essential to support bat Species of Concern such as Grey-headed Flying-foxes, native vegetation also provides a host of broader biodiversity benefits to a range of species and ecosystems.

- Areas where survey monitoring has detected the highest concentrations of bat activity regardless of vegetation type. If the methods recommended in this guidance have been followed, this should allow the proponent to avoid the areas with potentially greatest impact on bat Species of Concern.

Although estimates of appropriate buffers have been made in other jurisdictions, evidence of an appropriate buffer distance for Victorian species is limited. Depending on the characteristics of the site and the particular bat species, the greater the buffer distance around a key ecological or habitat feature the greater the potential to reduce mortality impacts<sup>13</sup>.

Proponents seeking to apply buffers to habitat features during the process of micro-siting should consult with DTP and DEECA as part of the pre-application process regarding the specifics of the site.

<sup>13</sup> DEECA has conducted an expert elicitation process that considered several mitigation options, such as buffer distances and options for curtailment, including cut-in speeds and periods of application, and their potential effectiveness Estimating the potential effectiveness of wind farm mitigations using structured expert elicitation. The results of this work provide estimates of the possible level of mortality reduction for bat Species of Concern resulting from applying the mitigation options, noting there is uncertainty across the estimates as explained in the report. Further research is ongoing to refine this information.



## 3.2 Measures for mitigating impacts to bat Species of Concern

### Measures for insectivorous bats

Table 15: Measures to mitigate impacts on insectivorous bats

Potential approach	Description	Approaches and options
<b>Nighttime low wind speed curtailment</b>	<p>Low windspeed curtailment involves raising the windspeed at which turbines begin to produce energy (the 'cut-in speed'), which is effective because insectivorous bats are more active during lower wind conditions.</p> <p>Bats are nocturnal; therefore, collision risk is restricted to between dusk and dawn. Any curtailment strategies aiming to reduce bat mortality do not need to be applied during daylight hours.</p> <p>Mortality risk varies seasonally in Victoria, with heightened risk periods occurring between the months of January and April inclusive. Average daily reduction in mortality when applying mitigation measures will be highest if applied during these periods, although continuous nighttime application throughout the year will return the highest total reduction in mortality.</p> <p>Species specific information, such as habitat usage, is an important consideration when selecting curtailment approaches, timing and seasonal duration of measures.</p>	<p>A range of approaches are available, from blanket curtailment below specified wind-speeds, to smart curtailment in response to monitored risk factors such as real-time data on environmental variables and bat activity. Smart curtailment can reduce the operational cost of curtailment while increasing effectiveness.</p> <p><b>Cut-in speed:</b> Higher cut-in speeds will result in a greater reduction in bat collision mortality.</p> <p><b>Timing:</b> In Victoria, peak bat activity is from September to May, with peak collision mortality recorded from January to April. Although the greatest reduction in mortality would result from year-round application of curtailment, curtailment during months associated with high activity levels or mortality rates is also likely to deliver significant reductions.</p> <p>Smart curtailment only at times of monitored high bat activity or other risk factors may return reduction in mortality at a similar rate to continuous dusk till dawn curtailment during low wind speeds over high activity months.</p>
<b>Feathering below cut-in speed</b>	Preventing turbines from 'freewheeling' below the windspeed at which turbines begin to produce energy, shown in other jurisdictions to be effective in reducing bat mortality without impacting facility output.	Reduced risk of impacts to bats by reducing time that blades are moving through airspace without impacting facility output.
<b>Acoustic deterrents</b>	Use of ultrasonic acoustic deterrents mounted on turbines designed to deter bats may reduce mortality of insectivorous bats. However, there is a level of uncertainty with this mitigation measure because the approach has not been trialled in Victoria, and results from other jurisdictions are variable.	<p>Encouraging bats to avoid the turbines through acoustic deterrence may reduce the likelihood of impacts occurring.</p> <p>If ultrasonic acoustic deterrents are to be trialled on proposed wind energy facilities, other proven mitigations methods should be adopted in combination to manage residual impacts to bats.</p>
<b>Increased turbine height</b>	The impact of increasing the height of the rotor swept area on bat mortality is variable and has been shown to both decrease and increase the risk across different species. Therefore, while this approach may reduce mortalities for some species, some risk will remain, and potential unintended negative impacts will need to be considered.	Rotor swept areas designed to operate above certain heights may avoid impinging on the flight paths of certain bat species.

Monitoring the effectiveness of any mitigation strategy through post-construction mortality monitoring will provide evidence of effectiveness of the approach taken and can allow adjustments to the regime to be made through an adaptive management framework.

### Mitigation measures for Grey-headed Flying-foxes

Although the above approaches may reduce mortalities of small insectivorous bats, their effectiveness for Grey-headed Flying-foxes, which are much larger size and have different ecology to other Victorian bat species, is yet to be trialled.

Options for mitigation measures that could be trialled for Grey-headed Flying-foxes are:

**Table 16: Measures to mitigate impacts on Grey-headed Flying-foxes**

Potential approach	Description	Outcome
<b>On demand shutdown (radar)</b>	Radar installed on site which would temporarily trigger a shutdown in real-time when a flying-fox was detected approaching a turbine and was at risk of collision.	Experts have estimated that in Victoria this approach could reduce collision mortality by approximately 50 per cent (with a high level of uncertainty).
<b>On demand shutdown (thermal/infrared cameras)</b>	Thermal or infrared cameras installed on site (e.g. linked with IdentiFlight or similar system), which would trigger a temporary shutdown in real-time when a flying-fox was detected approaching a turbine and was at risk of collision.	Experts have estimated that in Victoria this approach could reduce collision mortality by approximately 25 per cent (with a high level of uncertainty).
<b>Targeted shutdown (weather radar)</b>	Weather radar is used to monitor numbers of flying-foxes at nearby camp/s, and flight direction and timing on fly-out. Based on this data, turbine shutdowns would occur at times that turbine collision risk is considered 'high'.	Experts have estimated that in Victoria this approach could reduce collision mortality by approximately 30 per cent (with a high level of uncertainty).

### 3.3 Compensation for residual risk of impacts

Some residual level of risk or impact may remain after predicted impacts have been avoided, minimised and mitigated to the maximum extent practicable. The Handbook sets out requirements for compensation of residual impacts on threatened bird and bat species from a wind energy facility. It is recommended that relevant Action Statements, National Recovery Plans, and specific needs assessments (SNA), where available, are used for impacted bat species to identify possible compensatory measures.

# Appendix 4: Guidance for post-construction mortality monitoring for birds and bats from onshore wind energy facilities

This Appendix provides guidance on DEECA's preferred methodology for the carrying out of post-construction mortality surveys.

Monitoring should commence immediately after the turbines are commissioned and start operating.

## 1. Intended outcomes from mortality monitoring

Post-construction mortality monitoring is used to understand the impacts of a wind energy facility on birds and bats once it becomes operational. Survey results can help to understand whether assessed risk levels were appropriate, whether mitigation measures are operating as expected or whether adaptive management measures are required. Post-construction monitoring can also inform understanding of cumulative impacts across multiple wind energy facilities and at a state-level.

To estimate mortality rates information collected should include:

- the number of mortalities
- location of mortalities
- search effort, including how many turbines are searched and how often
- searcher efficiency/ detection success
- carcass persistence or scavenger rates.

The Species of Concern should be the primary focus for post-construction mortality monitoring. However, monitoring should also record all bird and bat species found during searches to contribute to knowledge of the species being impacted and improve understanding of the drivers of mortalities.

## 2. Turbine selection

Wherever possible, all turbines in the wind energy facility should be included in mortality searches, noting this may not be practically feasible at large wind energy facilities. Where all turbines are searched, results will provide a high degree of confidence in the estimated level of ongoing impact.

Where more than 30 per cent of turbines are searched, results should estimate impact levels with a reasonable level of confidence if data collection is rigorous. However, specific characteristics of a site or unexpected results may trigger the need for increased monitoring to deal with remaining uncertainty, which should be prescribed in BAM Plans.

Where less than 30 per cent of turbines are proposed to be searched, a high degree of uncertainty will be associated with results and applicants should outline how they will address that uncertainty.

As there can be marked variation in annual mortality rates between turbines, if a proportion of turbines is to be searched, rather than all turbines, the following should be considered:

- The number selected should be rounded up to the nearest whole turbine.
- Any turbines pre-determined to present high mortality risk, for example based on pre-construction utilisation surveys or any post-construction monitoring already undertaken, should be included in the sample of turbines to be searched.
- The remaining sample should be stratified to ensure representation of factors such as habitat type, unlit versus lit turbines, and turbines located at the edge versus interior of the site, where relevant. Within these stratifications by factor, turbines should be chosen randomly without bias to ensure a representative sample.
- If stratification is not relevant to the site, then turbines should be randomly selected.
- Changing the selection of turbines each year will increase the likelihood that any mortality 'hotspots' are not missed. If this approach is applied, keeping a subset of turbines consistent between years will allow for comparisons of patterns between seasons and years.

## 3. Search area

The area to be searched under each turbine needs to be defined to ensure consistent search effort for each mortality survey. The search area should be defined in relation to the maximum fall zone for a carcass after collision, so that the proportion that are likely to fall outside the search area can be factored into the overall mortality estimates.

The fall zone of carcasses is broadly related to the turbine size. A search area linked to maximum blade tip height in the study design should therefore ensure the area is consistently scaled to different turbine sizes across different wind energy facilities. A search area based on modelled maximum fall distances should provide a consistent proportion of the mortalities to include in mortality estimate calculations.



Some uncertainty is inherent as modelling methods rely on, or are influenced by, a range of assumptions, for example, unknown aerodynamic drag parameters. Fall distance is also likely to be affected by factors such as prevailing wind direction, flight patterns and behaviour of species and the operating speed of the turbine, minimum ground clearance of the turbine blades, and the radial distribution of collisions across the turbine blades.

In all cases, clear documentation and justification for the design of the search area needs to be provided.

#### 4. Search method and carcass detection protocol

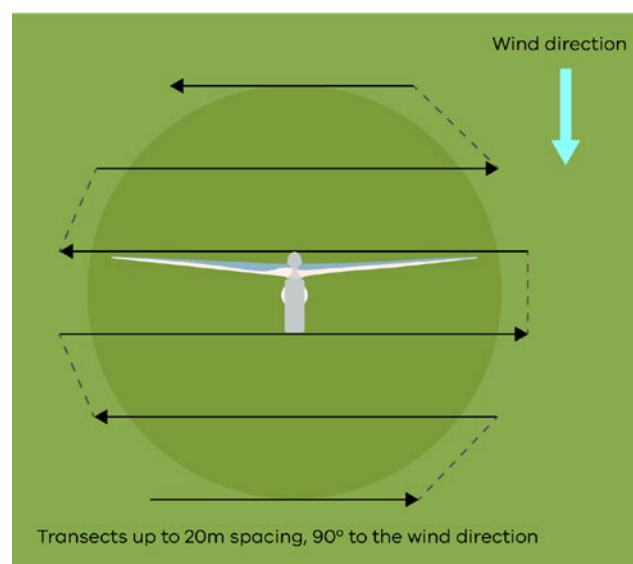
Searches are conducted with either detection dogs or human searchers. Research, both in Australia and internationally, shows that detection dogs have a higher detection success and efficiency, especially for smaller birds and bats, and therefore is the preferred approach where feasible and practicable.

Human searchers have lower search efficiency and detection success. Any approaches proposing the use of human searchers should provide justification for the choice and report efficiency rates.

When using detection dogs to undertake searches, the following matters must be considered:

- Dogs used for searches must be trained in air scenting target odours (birds and bats).
- Handlers should have demonstrated experience in working with detection dogs, and a bond with the dog used, as well as experience in identifying local bats and birds to species level.
- Dog-handler teams should commence surveys downwind of the survey area and work perpendicular to the prevailing wind to maximise the probability of encountering scent cones produced by carcasses.
- Transects should be a maximum of 20m wide to avoid reduced efficiency, and the width should be reduced in unfavourable scent conditions such as high or still wind, tall vegetation, or when targeting small species.

- Collecting data on effort or time searching per area can help in comparisons between different dog-handler teams and provides important information for evaluating consistency and performance. In addition, information on start and finish times of each survey is important for evaluating fatigue, time of day and weather impacts when interpreting results. Dog tracks should be recorded with GPS collars, with the duration of search and the area searched recorded for each survey in minutes per hectare and submitted with survey data.
- Regular breaks, e.g. 5 min for every 20 min searching, and avoiding actively searching for more than 3–4 hours per day or searching during hot weather should maintain both animal welfare and optimal searcher efficiency. Panting decreases dogs' abilities to detect scent.
- Undertaking dog searches early in the morning reduces the chance that diurnal scavengers remove carcasses of nocturnal species before they are found and also avoids high temperatures.



**Figure 6:** Searches by trained detection dogs are undertaken perpendicular to the wind direction, commencing downwind of the search area and using 20 m spacing or less, depending on the scent conditions.

## 5. Searcher efficiency trials

Searcher efficiency is the probability that carcasses are successfully detected by searchers when present in the search area. It is important to know the proportion of carcasses that are likely to have been missed to accurately estimate annual mortality rates. This proportion is estimated by conducting searcher efficiency trials.

Best results will be obtained from searcher efficiency trials when:

- Carcasses of each of the target groups of interest, i.e. small birds, medium birds, large birds, small bats, and flying-foxes, are used. Carcass proxies are not appropriate for searcher efficiency trials when using dogs, because they detect targets by scent.
- When humans are placing test carcasses, an easy scent trail is not left for dogs to follow directly to the target. Where possible, multiple people walking randomly throughout the survey area prior to the dog searching will help eliminate the dog tracking the person who placed the target to the carcass.
- Searcher efficiency trials are 'blind', i.e. dog handlers or human searchers should not be aware that the trial is being undertaken or of the number and type of carcasses placed. Observers aware of the target location should not be present during the survey.
- The number of carcasses used in each trial should vary, with some surveys containing zero carcasses.
- Searcher efficiency trials are integrated into normal searches (e.g. a couple carcasses per survey) for more realistically simulation of searcher efficiency.
- Testing of dog-handler teams occurs under the conditions that normal searches are undertaken so that factors such as fatigue and time of day are taken into consideration. For example, while morning searches are recommended, if searches will be undertaken at different times of day, then searcher efficiency should also be tested at different times of day to account for the effect of this variation.
- Separate searcher efficiency estimates are calculated for each dog-handler team due to differences in dog performance with different handlers.
- Search effort during the searcher efficiency trials is reported as the total search time per unit of area searched, e.g. minutes per hectare, to enable comparisons of consistency between searches and trials, between dog-handler teams, and under different conditions. This includes submitting GPS tracks from dogs alongside reporting data.

- The proportion of carcasses found is reported for each survey for each of the target groups (i.e. small birds, medium birds, large birds, small bats, flying-foxes).

Where appropriate searcher efficiency estimates based on an equivalent context are available, these may be an acceptable proxy for trial-derived estimates. Proponents should consult with DEECA before adopting this approach.

## 6. Carcass persistence trials

Carcass persistence trials or 'scavenger trials' determine how long carcasses remain in place before they are no longer detectable because they are removed by scavengers or degrade in the environment.

Considerations for carcass persistence trials:

- Because carcass persistence times vary with body size and between different taxa, trials should be undertaken for each target group, i.e. small birds, medium birds, large birds, small bats, and flying-foxes.
- Using like-for-like carcass types in trials will ensure accurate results for each carcass type or size class. Carcasses may be available from sources such as mortalities from turbine searches, heat stress events (flying-foxes), road collisions or animals that have died while in care, e.g. sourced from wildlife carers.
- Where proxies for carcass persistence trials are required, dark-coloured mice may be substituted for insectivorous bats. Scavenging times for mice have been shown to differ slightly to insectivorous bats in Victoria, though they follow a similar pattern and are therefore considered to be reasonable proxy if bat carcasses cannot be accessed.
- Accuracy of results generated where rabbits are substituted for flying-foxes in Victoria remains unclear, and confidence in results will be increased where this proxy has been calibrated with scavenger rates for flying-fox carcasses to determine its validity for providing accurate estimates.
- Carcass persistence trials undertaken every season over the monitoring program will account for seasonal variation.
- Trials undertaken over the full range of habitats present will account for spatial variation across the site, for example whether some areas are likely to have more scavengers than others based on the vegetation cover.

- Carcass persistence is influenced by factors such as rain and the types and numbers of scavengers present so results cannot be assumed valid if transferred from one site to another.
- Heat-and-motion cameras or regular site visits are typically used to determine the approximate time of removal or decomposition. Cameras provide advantages such as more precise times that carcasses are removed, determining the species that removed the carcass, and reducing the number of site visits required.

Practices that will improve accuracy of carcass persistence trial results:

- Carcasses are marked discreetly so that they can be discerned from actual mortalities.
- Carcasses are dropped from waist height rather than placing them directly on the ground.
- The location is recorded with a GPS.
- No more than two trial carcasses placed at any one turbine at a time to avoid altering typical scavenger activity at the site.
- If using the manual checking approach, site visits are undertaken on at least Day 1, 2, 3, 4, 7, 14, 21, and 30 (or longer for raptors). Fewer visits are needed when using camera traps, however cameras will still require checking to minimise data loss, e.g. checking for equipment failures or loss of cameras.
- The total number of carcasses of each type and size class to be used in the trials is guided by a statistician/biometrician.

Where appropriate carcass persistence estimates based on an equivalent context are available from other scientifically robust sources, these may be an acceptable proxy for trial-derived estimates. Proponents should consult with DEECA before adopting this approach.

## 7. Search intervals

Search intervals between mortality surveys effect the likelihood of detecting and correctly identifying carcasses, particularly for small-bodied species that are more likely to be scavenged quickly or decompose, which influences the accuracy of resulting mortality estimates.

Short search intervals of for example every 3–4 days are more likely to detect small-bodied species.

Intermediate intervals of for example 7 days may be appropriate where small-bodied species are not a focus of surveys.

Monthly surveys are likely to miss many mortalities due to carcass loss through scavenging. The addition of pulse surveys 2–3 days after standard monthly searches strikes a balance between short intervals suited to recovering small-bodied insectivorous bats and seasonal coverage across the year.

Higher sampling frequency over periods of higher collision risk for bats (late summer / autumn) will provide more robust data to assess bat mortality rates.

## 8. Identification, handling and management of carcasses or injured wildlife

Bat carcasses collected during mortality surveys and as incidental finds should be handled using gloves and by practitioners that are fully vaccinated for Australian Bat Lyssavirus and maintaining ongoing immunity through titre checks and obtaining boosters as required.

Any live, injured wildlife found should be transported to the nearest veterinary clinic. Victoria's Help for Injured Wildlife Tool<sup>14</sup> provides information on safety considerations and helpful contacts.

All carcasses collected during surveys or as incidental finds should be identified to species level, and where the condition of the carcass and presence of identifying features permits, identified by sex and life stage (adult, juvenile). Carcasses are to be kept frozen until they are no longer required, for example until any investigations and assessments have been undertaken. Carcasses may be able to be stored and used in future searcher efficiency and carcass persistence trials.

The handling, management and disposal of wildlife carcasses is a regulated by the *Wildlife Act 1975*. Proponents should consult with the Conservation Regulator to understand what authorisations may be required.

DEECA recommends that engagement with Traditional Owners or First Nations people is undertaken in the planning stages to understand any culturally sensitive management protocols for treatment of carcasses that may be requested, particularly for any culturally significant species.

<sup>14</sup> <https://www.wildlife.vic.gov.au/injured-native-wildlife/wildlife-tool>

## 9. Minimum data requirements

The following data is required to estimate annual mortalities of birds and bats at wind energy facilities from post-construction mortality monitoring data.

**Table 17: Minimum data requirements for post-construction mortality monitoring**

Data category	Details required
Turbine details	<p>For each turbine on each wind energy facility the following details are required:</p> <ul style="list-style-type: none"> <li>• Turbine identification number</li> <li>• GPS location</li> <li>• Description of location of turbine – such as raw if turbine is located on edge or in the centre of the array, availability of bird or bat habitat nearby, e.g. native vegetation or scattered paddock trees, wetlands.</li> <li>• Blade length</li> <li>• Minimum swept height (metres above ground)</li> <li>• Maximum swept height (metres above ground)</li> <li>• Hub height</li> <li>• Hardstand area (square metres)</li> <li>• Date the turbine commenced operations</li> <li>• Turbine lit – if the turbine has lights and if it was lit during the previous month</li> </ul>
Searcher efficiency trials	<p>For each time searcher efficiency trials were undertaken at a wind energy facility, the following information is required:</p> <ul style="list-style-type: none"> <li>• Date of trial</li> <li>• Weather conditions on day of trial</li> <li>• Blind trial – were searchers aware that a trial was being undertaken on that day, and if so, were they aware of the number of carcasses?</li> <li>• Name of the searcher</li> <li>• If a dog was used provide the name of the dog <ul style="list-style-type: none"> <li>– Search transect details – include total area searched, distance walked and time spent searching, and the number of turbines searched.</li> <li>– Was it done as part of the normal mortality survey or specifically as a trial?</li> <li>– Were the carcasses randomly spread?</li> <li>– To what distance from the base were they spread?</li> <li>– For dog searches, the search effort (time per hectare searched) should be reported and the GPS-tracks from the GPS-logger carried by the dogs should be submitted.</li> </ul> </li> </ul> <p>For each type of carcass – large bird, medium bird, small bird, small bat and flying-fox – provide the following:</p> <ul style="list-style-type: none"> <li>• Carcass – what species was used to simulate the carcass type?</li> <li>• Vegetation type (the density of the vegetation will influence detectability, so it would be useful to determine detectability for a range of vegetation types): <ul style="list-style-type: none"> <li>– Bare ground</li> <li>– Short or sparse vegetation – e.g. short grass</li> <li>– Long or dense vegetation – e.g. long grass or heath</li> </ul> </li> <li>• Number of carcasses deployed, and the number found in each vegetation type.</li> </ul>

Data category	Details required
Carcass persistence trials	<p>For each carcass used in a carcass persistence trial at a wind energy facility, provide the following information:</p> <ul style="list-style-type: none"> <li>• The category of carcass – i.e. large bird, medium bird, small bird, small bat, flying-fox</li> <li>• Carcass – the species of carcass</li> <li>• The date the carcass was put in place</li> <li>• The turbine it was closest to</li> <li>• Vegetation – virtually none, short or sparse vegetation, dense or long vegetation</li> <li>• Pest control etc. – date and details of any pest control that could impact carcass persistence rates, e.g. rabbit control, fox baiting, or other activities such as lambing under turbines, carrion removal</li> <li>• The number of days the carcass was checked and frequency of checks and/or the timing of camera trap deployment and checks after deployment.</li> <li>• For each check: <ul style="list-style-type: none"> <li>– Date</li> <li>– Weather – general weather conditions since previous check – e.g. temperature and rainfall (as these will affect decomposition rates)</li> <li>– Condition of carcass – e.g. intact, partly scavenged, remnants only (e.g. feathers) or completely removed.</li> </ul> </li> </ul>
Mortality surveys	<p>For each mortality survey undertaken at a wind energy facility, collect the following data – record information on all surveys irrespective of whether carcasses were located.</p> <ul style="list-style-type: none"> <li>• Date of survey</li> <li>• The number of turbines searched</li> <li>• Were turbines cleared of existing carcasses prior to commencement of scheduled searches? If so, how many days prior to the search?</li> <li>• Pest control, etc. – date and details of any pest control that could impact observation rates, e.g. rabbit control, fox baiting, or other activities such as lambing under turbines, carrion removal.</li> <li>• Weather conditions on the day of the survey</li> <li>• For each individual turbine searched: <ul style="list-style-type: none"> <li>– Turbine number</li> <li>– Searcher's name</li> <li>– Dog's name if used</li> <li>– Search method – describe the search method, including duration of search, transect width, shape of search area, distance out from base, if GPS track was taken, etc.</li> <li>– Search area – estimated total area searched in square metres</li> <li>– Percentage of area searched that was bare ground</li> <li>– Percentage of area searched that was short or sparse vegetation</li> <li>– Percentage of area that was long or dense vegetation</li> <li>– Percentage of time the turbine was operational over the past 5 days</li> <li>– Percentage of time the turbine was operational over the past 30 days</li> <li>– Total number of carcasses detected in this search at this turbine.</li> </ul> </li> <li>• For each carcass: <ul style="list-style-type: none"> <li>– Species</li> <li>– Condition – injured, intact carcass, partial remains, scavenged, feathers only, etc.</li> <li>– GPS location</li> <li>– Distance to turbine base</li> <li>– Direction to turbine base (bearing)</li> <li>– Carcass identifier – who identified the species?</li> <li>– Vegetation within general vicinity of carcass – bare ground, short or sparse vegetation, dense or long vegetation</li> </ul> </li> </ul>

Data category	Details required
Incidental finds	<p>For any incidental finds outside of the mortality surveys, collect a subset of the above data including:</p> <ul style="list-style-type: none"> <li>• Turbine number</li> <li>• Date</li> <li>• Searcher</li> <li>• Species</li> <li>• Condition – injured, intact carcass, partial remains, scavenged, feathers only, etc.</li> <li>• GPS location</li> <li>• Distance to turbine base</li> <li>• Direction to turbine base (bearing)</li> <li>• Carcass identifier – who identified the species?</li> <li>• Fate of carcass – was it removed or left in place to be included in mortality surveys?</li> <li>• Vegetation within general vicinity of carcass – bare ground, short or sparse vegetation, dense or long vegetation.</li> </ul> <p>Where carcasses are found incidentally outside the standardised mortality monitoring surveys, they should be recorded and reported, removed and stored in the same way as for carcasses found in normal surveys.</p> <p>Unless there is clear evidence that an incidental mortality find did not result from collision with a turbine, carcasses found within search plots but outside of a formal search should be included in mortality estimates under the assumption that the carcass would have been found in the next survey. Carcasses found outside of defined search areas around turbines should not be included in mortality estimates but do provide valuable information regarding the species being impacted.</p>

## 10. Estimating annual mortality rates

The number of mortalities found during mortality surveys is only a proportion of the true number of mortalities occurring at a wind energy facility. By using additional information, including search effort and the results from searcher efficiency and carcass persistence trials, the annual mortality rates can be estimated for individual species. This information is critical for understanding the true number of individuals killed each year.

Mortality rate estimation should use statistically valid approaches (see below) for estimating mortality rates and provide estimates of variability/confidence/error associated with the estimates. The annual mortality rates should incorporate and be adjusted for:

- Search effort, including the number of turbines searched and the survey intervals
- Searcher efficiency rates
- Carcass persistence rates.

The number of mortalities likely to have been missed due to falling outside of the searched area (e.g. density weighted proportion of area searched).

Species-specific annual mortality rates should be estimated for each Species of Concern that have been detected as mortalities. Consideration should also be given to estimating rates for any other bird and bat species, such as highly-impacted or culturally significant species. It is recommended to report mortality estimates as a total across each wind energy facility per year, as well as on a per turbine and per MW basis.

A range of statistically valid approaches have been used for estimating annual mortality rates. Internationally, a standardised approach has been developed called GenEst – A Generalized Estimator of Mortality (<https://connect.west-inc.com/GenEst/>). This is a software platform into which numbers on mortalities, search effort, searcher efficiency and carcass persistence rates are entered, that then provides estimates of mortality with the associated uncertainty. This tool assumes regular survey intervals and cannot accommodate the pulse survey approach that is often undertaken in Victoria. More bespoke models are typically used in Victoria that can incorporate the pulse survey approach and also provide more interpretation on false negatives (i.e. where carcasses occur but have not been found).



## 11. Post-construction bat utilisation surveys

Post-construction utilisation surveys can provide further information and support comparison of the levels of bat activity before and after the construction of the turbines, to help interpret the mortality data and more fully understand the potential impacts of the wind energy facility.

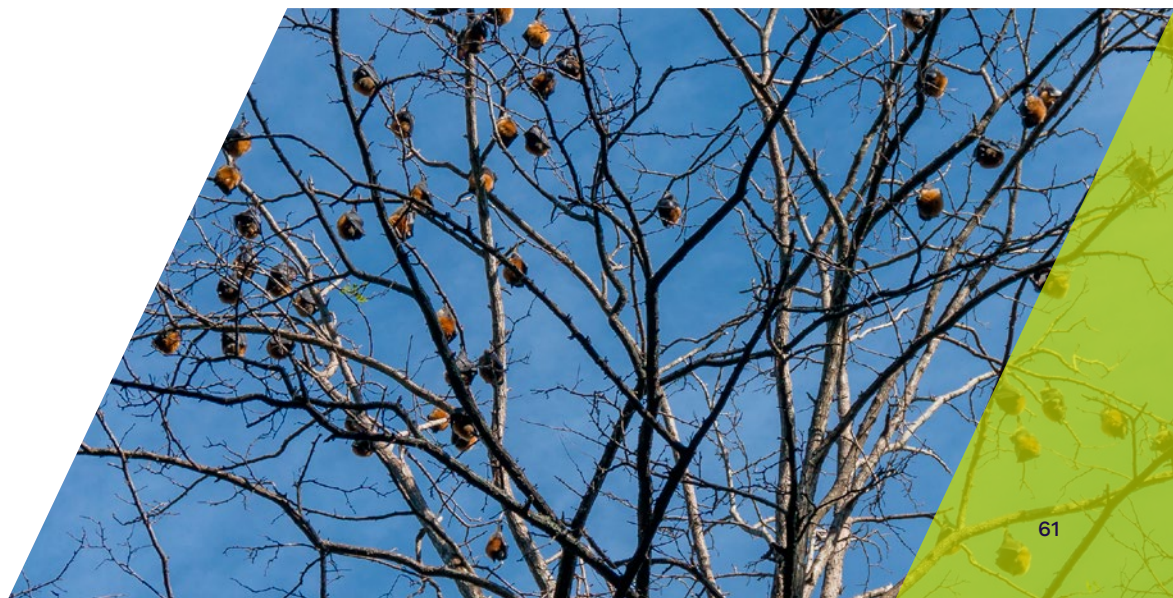
Post-construction bat utilisation surveys can be undertaken in a similar way to pre-construction utilisation surveys. Benefits include:

- Post-construction bat activity at turbine nacelle can provide a good estimate of mortality risk to bats. This information can be valuable for supplementing data from post-construction mortality monitoring, especially for threatened species which can be difficult to detect in mortality surveys due to comparatively smaller numbers of mortalities (i.e. which are therefore more likely to be missed between survey periods) and because small bat species are scavenged very quickly.
- Acoustic monitoring of bat activity at nacelle, together with monitoring of weather and environmental variables such as temperature, windspeed and rainfall, can inform a site-specific 'smart' curtailment program which may be able to reduce energy loss through making curtailment as targeted as possible to identified risk factors for the species at risk.
- Information generated could inform investigations into indirect impacts such as habitat displacement or disturbance, or any attraction effects.

## 12. Data accessibility

External reporting and data disclosure/accessibility is important to enable meta-analyses to understand cumulative and population-level risks to species, informing strategic planning processes and future assessments, and to facilitate collaborative learning about the effectiveness of different mitigation measures.

Data collected based on minimum data requirements should be submitted to DEECA on an annual basis and made publicly available (subject to any necessary redactions for confidentiality or privacy reasons or related to ecologically sensitive information). All pre- and post-construction survey and monitoring data should also be entered into the Victorian Biodiversity Atlas.



# Appendix 5: Guidance for developing Bat and Avifauna Management (BAM) Plans for onshore wind energy facilities

This guidance outlines information that can be included in a BAM Plan for threatened bird and bat species for onshore wind energy facilities. The specific monitoring, reporting and adaptive management requirements to include in a BAM Plan may vary depending on the project, the risks and impacts to threatened bird or bat species and the level of effectiveness or uncertainty of measures adopted under the mitigation hierarchy.

## 1. Objectives

A BAM Plan is used to monitor and report on the impacts of a wind energy facility once it has commenced operation. They also support the systematic collection and reporting of data that can be used to improve understanding of the local and cumulative impacts of wind energy facilities on threatened bird and species, which can inform and improve future decisions in relation to wind energy facilities.

The BAM Plan must be consistent with this Handbook and, where required, any conditions of the planning permit for the wind energy facility. Any required revisions to the BAM Plan may be undertaken as secondary consents (post-approval) to satisfy specific permit requirements.

The BAM Plan may also contain requirements related to the following:

- Monitoring the presence and behaviour of birds and bats and the impacts of the wind energy facility on threatened bird and bat species at the site or in the surrounding area.
- Avoid, minimise and mitigation measures to be applied to manage risks and impacts to threatened bird and bat species and how these will be monitored.
- The implementation actions for delivery of compensatory measures, if any, as per Section 6.4 of the Handbook.
- Defining triggers and procedures for the adaptive management of residual impacts from the wind energy facility and / or in response to new information and/or conditions.

- Methods for post-construction mortality monitoring for bird and bat species as per Appendix 4.
- Procedures for the collection and disposal of bird and bat carcasses under turbines and the care of injured birds and bats on site for the life of the wind energy facility. This includes working with Traditional Owners and First Nations groups where appropriate.
- Procedures, formats and frequency for periodic reporting to the responsible planning authority and DEECA within agreed-upon timeframes and making reports publicly available (subject to any necessary redactions for confidentiality or privacy reasons or related to ecologically sensitive information).

## 2. Project Description

Description of the project including project type, scale and anticipated operating life.

### Site and project description

Describe the site location and project, including the number and specifications of turbines such as hub height, minimum and maximum rotor swept height, power.

### Site Map

The Site Map must include grid lines in decimal degrees, and show water bodies and native and non-native vegetation, major and minor roads, turbine locations, numbers and elevation contours. It must also mark which turbines will be searched during post-construction mortality monitoring.

### Planning Permit conditions (where applicable)

Include a table that demonstrates each of the conditions relating to bird and bat management listed in the planning permit for the wind energy facility.

### Species occurring or likely to occur at the site or in the surrounding area

Outline all threatened bird and bat species occurring or likely to occur at the site or in the surrounding area.

Clearly identify if any threatened bird and bat species are listed on DEECA's Species of Concern List.

Clearly identify if any bird and bat species have been identified by Traditional Owners or First Nations groups as being of cultural significance.

### 3. Pre-construction Utilisation Surveys

Pre-construction utilisation surveys document a baseline of threatened bird and bat activity recorded at the project area and surrounding area prior to construction and operation of the wind energy facility.

Include information on pre-construction bird and bat utilisation surveys and specific monitoring and desktop assessments undertaken for Species of Concern, including the methods, survey effort and limitations. This will ensure the information it is accessible to stakeholders, regulators, and the public.

### 4. Post-construction utilisation surveys

Post-construction utilisation surveys provide information about bird and bat activity at and near the site following turbine commissioning and provide context for interpreting mortality results. Such surveys can be used to compare the levels of bird and bat activity before and after the construction and operation of the turbines to help interpret the mortality data and more fully understand the potential impacts from any displacement, disturbance or barrier effects that might result from a wind energy facility.

Include information on post-construction bird and bat utilisation surveys and specific monitoring and desktop assessments undertaken for Species of Concern, including the methods, survey effort and limitations. This will ensure the information is accessible to stakeholders, regulators, and the public.

### 5. Post-construction mortality monitoring

The aim of post-construction monitoring is to record and understand the impacts that the wind energy facility is having on bird and bat species, including Species of Concern, and to enable annual mortality estimates to be calculated. This requires information from mortality searches, including trials to determine searcher efficiency rates (the likelihood of carcasses present to be found by searchers) and carcass persistence rates (how long a carcass is likely to remain available to be found) at the facility.

Describe methods for post-construction monitoring, taking into account the guidance in **Appendix 4**.

Proponents are required to record and report all mortalities of bird and bat species as part of their reporting obligations (see below).

Estimating the actual impacts of a wind energy facility on birds and bats enables an assessment of whether measures under the mitigation hierarchy are required to manage residual impacts to acceptable levels and informs decision-making and research on cumulative impacts.

#### Length of monitoring period

Describe the post-construction monitoring period, including the total length of time, period of continuous monitoring and subsequent intervals of monitoring [see **Section 7.1** of the Handbook].

## 6. Applying measures under the mitigation hierarchy

### **Avoid, minimise and mitigation measures**

Describe the avoid, minimise and mitigation measures that will be applied to manage the operational impacts of the wind energy facility and how these will be monitored.

### **Compensation arrangements**

Where a proponent has agreed to deliver compensatory measures to manage residual risks and impacts from the wind energy facility, describe those measures and the implementation plan.

[see **Section 6.4** of the Handbook]

## 7. Adaptive management triggers and actions

Outline the adaptive management approach to be adopted for the wind energy facility to manage residual impacts and / or impacts that arise from new information and/or conditions. This should include triggers that define an impact threshold and measures the operator will undertake in the event a threshold impact is reached.

Defining triggers should factor in the avoid, minimise and mitigation measures to be applied to the wind energy facility, and specifically consider the potential for increased level of impacts than what was predicted as part of pre-construction assessment.

Measures to mitigate and/or compensate for the impacts above thresholds should be clearly outlined, including an explanation about how they respond to the impact and are proportionate to the nature and significance of the impact. Flexible approaches can be adopted by outlining options for adaptive management measures when triggers are met. In this case, the process to determine which option will be applied, including any consultation with DEECA or the responsible planning authority, must be clearly outlined.

All triggers and adaptive management measures should be based on the best available information.





## 8. Reporting requirements

### Notification of mortalities

Outline agreed triggers and timeframes within which DEECA and the responsible planning authority – and Traditional Owners if requested – will be notified of mortalities to threatened bird and bat species. Examples of where this may be required include:

- mortalities of Species of Concern
- if the wind energy facility has been assessed as having significant residual impacts
- where the wind energy facility is located in close proximity to an important ecological feature for threatened bird or bat species
- where there is a spike in mortalities recorded compared to other reporting periods.

Specific notification triggers may be set out in planning permit conditions.

Notification of mortalities ensures that regulators are aware of emerging impacts and the potential need for imminent review of responses. This is separate to and distinct from full reporting requirements (outlined below).

### Annual and periodic reporting of mortalities

A key responsibility for an operator of a wind energy facility is reporting of the results of post-construction monitoring. The operator of the wind energy facility should notify the responsible planning authority and DEECA once post-construction monitoring has commenced. The notification should include a schedule of when the responsible planning authority and DEECA will receive the submitted annual reports.

An annual report must be prepared after each year (12 months) of continuous monitoring. The first 12 months commences on the day of commencing operation of the wind energy facility, noting that there may be a need for monitoring activity based on staged development and commissioning of a facility [see **Section 7.1** of the Handbook]. For periodic monitoring, a report should be prepared at the end of the period.

Matters to be addressed in reports include, but are not limited to:

- A brief description of the management prescriptions implemented, and identification of any modifications made to the original management practices.
- The survey methods (including list of observers, dates, and times of observations).
- Results of carcass searches and incidental carcass observations.
- Estimates of bird and bat mortality rates (total mortality at the facility per year and mortalities per turbine per year) based on statistical analysis, factoring in search effort (frequency and number of turbines), searcher efficiency rates and carcass persistence rates. Species-specific annual mortality estimates will be calculated for Species of Concern and any other specific species as directed by DEECA.
- Seasonal and annual variation in the number and composition of bird and bat strikes, where detectable.
- Any mortality notification and adaptive management triggers that occurred in the monitoring period and a summary of the response/s implemented.
- Information related to any specific obligation contained in the planning approval.
- A discussion of the results, including:
  - mortality impacts to bird and bat species, specifically identifying if they are Species of Concern
  - the effectiveness of measures under the mitigation hierarchy applied to the wind energy facility to manage risks and impacts
  - any further recommendations for reducing mortality, if necessary
  - a comparison of current and previous post-construction monitoring periods (not required for the first annual report).
  - comparisons of the estimated number of birds and bat mortalities (from the statistical analysis of monitoring data) against the predicted level of impacts from the bird and bat impact assessments.

Raw data and the reports should be submitted to DEECA and the responsible planning authority within two months of the completion of each 12 months or relevant period of mortality monitoring. The raw data must be in the form set in out in Section 9 of this BAM Plan guidance.

All records of threatened bird and bat species should also be entered into the Victorian Biodiversity Atlas (VBA).

9. BAM Plan: Raw Data spreadsheet

Wind Farm Name	Date found	Turbine number/code	Scientific Name	Common Name	Type (Bird/ Bat)	Distance from turbine (m)



[illegible]

## Appendix 6: Glossary of Key Terms

Term	Explanation
<b>Action Statements</b>	Legislative tool made under the <i>Flora and Fauna Guarantee Act 1988</i> and used to inform conservation and investment decisions for the recovery of threatened species and communities, and managing and mitigating potentially threatening processes. <a href="https://www.environment.vic.gov.au/conserving-threatened-species/action-statements">https://www.environment.vic.gov.au/conserving-threatened-species/action-statements</a>
<b>Breeding area / habitat</b>	An area or habitat used by a species during its breeding cycle.
<b>Compensation</b>	Action taken to address any negative residual impacts such as habitat loss, animal mortality or injury that cannot be avoided or mitigated. For the purpose of this Handbook, includes direct and indirect compensation. See Section 6.3 of the Handbook.
<b>Cut-in speed</b>	The wind speed at which a turbine begins to generate electrical power.
<b>DEECA</b>	Department of Energy, Environment and Climate Action
<b>Direct compensation</b>	Carrying out, either directly or by engaging a third party, on-ground actions that directly benefit the impacted threatened bird and/or bat species' populations. See Section 6.3 of the Handbook.
<b>Direct impacts</b>	An impact that is a direct consequence of an action. Immediate and traceable effects of an action or development on threatened bird and bat species.
<b>DTP</b>	Department of Transport and Planning
<b>EE Act</b>	<i>Environment Effects Act 1978</i> (Victoria)
<b>Electricity transmission lines</b>	Includes powerlines to transmit, distribute or store power, consistent with the definition of utility installation in clause 73.03 of the Victoria Planning Provisions.
<b>Environment Effects Statement / EES</b>	Environmental impact assessment of proposed project works capable of having a significant effect on the environment. The EES process is the highest level of environmental assessment in Victoria.
<b>EES Ministerial Guidelines</b>	<i>Ministerial guidelines for assessment of environment effects</i> (8th edition) <a href="https://www.planning.vic.gov.au/environmental-assessments/environmental-assessment-guides/ministerial-guidelines-for-assessment-of-environmental-effects">https://www.planning.vic.gov.au/environmental-assessments/environmental-assessment-guides/ministerial-guidelines-for-assessment-of-environmental-effects</a>
<b>EPBC Act</b>	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
<b>FFG Act</b>	<i>Flora and Fauna Guarantee Act 1988</i> (Victoria)
<b>Foraging area / habitat</b>	An area or habitat in which threatened bird and bat species hunt or search for food.
<b>Habitat Value map</b>	The Habitat Value map combines information on thousands of species habitats to show the relative biodiversity value of landscapes in Victoria. <a href="https://www.environment.vic.gov.au/biodiversity/habitat_value">https://www.environment.vic.gov.au/biodiversity/habitat_value</a>
<b>Indirect compensation</b>	Delivering, either directly or by funding a third party, research or education outcomes and/or programs that are designed to indirectly benefit the impacted threatened bird or bat species by helping to address key knowledge gaps in species' behaviour, fecundity, habitat and other matters that are essential to ensuring their long-term survival. See Section 6.3 of the Handbook.
<b>Indirect impacts</b>	Impacts that are an indirect consequence of an action.
<b>Local planning scheme</b>	Planning schemes contain policies and provisions that control land use and development. They are made up of maps and ordinance.

Term	Explanation
<b>Mitigation measure</b>	Action taken to mitigate, reduce or minimise any negative impact on threatened bird and bat species, such as habitat loss, animal fatality or injury, where it is not possible to avoid such impacts. See Section 6.3 of the Handbook.
<b>Mitigation hierarchy</b>	The mitigation hierarchy is a tool that is used to limit the amount of damage an action, such as a development, will have on the environment. For the purposes of this Handbook, there are four steps – avoid, minimise, mitigate, compensate – and each step must be followed in order and to the maximum extent practicable before moving on to the next. See Section 6.3 of the Handbook.
<b>Mortality monitoring</b>	The counting and recording of bird and bat mortalities at a specific onshore wind energy facility. Mortality monitoring is used to understand the impacts of a wind energy facility on birds and bats once it becomes operational.
<b>National Recovery Plan</b>	Plans adopted by the Commonwealth Government under the EPBC Act which set out research and management actions to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. <a href="https://www.dcceew.gov.au/environment/biodiversity/threatened/recovery-plans/made-or-adopted">https://www.dcceew.gov.au/environment/biodiversity/threatened/recovery-plans/made-or-adopted</a> <a href="http://www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl">http://www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl</a>
<b>Onshore wind energy facility</b>	Has the same meaning as ‘wind energy facility’ in clause 73.03 of the Victoria Planning Provisions.
<b>P&amp;E Act</b>	<i>Planning and Environment Act 1987</i> (Victoria)
<b>Renewable energy facility</b>	Has the same meaning as in clause 73.03 of the Victoria Planning Provisions.
<b>Residual impacts</b>	Residual impacts refer to the negative effects of a project or activity that remain after avoid, minimise and mitigation measures have been applied.
<b>Risk-based approach</b>	A strategic way to manage risks by focusing on the most critical issues. It involves identifying, assessing, and prioritising risks, then implementing measures to manage them, and continuously monitoring and reviewing these measures.
<b>Roosting sites/ roosts</b>	A location where birds or bats rest and breed.
<b>Species of Concern</b>	Threatened bird and bat species identified by DEECA as being most at risk of collision from the operation of onshore wind energy facilities in Victoria – see Appendix 1.
<b>Specific Needs Assessment</b>	A structured decision support process for estimating the benefits and cost-effectiveness of a range of management scenarios for an individual threatened species, a population or an ecosystem.
<b>Strategic Management Prospects (SMP)</b>	A spatially explicit tool that shows where and how we can take cost-effective action to make the biggest difference for as many species as possible across Victoria, and guide on-ground management to deliver Biodiversity 2037. <a href="https://www.environment.vic.gov.au/biodiversity/choosing-actions-for-nature">https://www.environment.vic.gov.au/biodiversity/choosing-actions-for-nature</a>
<b>Threatened bird and bat species</b>	Bird and bat species included on the Threatened List made under the <i>Flora and Fauna Guarantee Act 1988</i> .
<b>Turbine</b>	A machine that turns wind energy into electricity.
<b>Victoria Planning Provisions</b>	The Victoria Planning Provisions are the standard provisions that form the framework for all of Victoria’s planning schemes. <a href="https://planning-schemes.app.planning.vic.gov.au/Victoria%20Planning%20Provisions/ordinance">https://planning-schemes.app.planning.vic.gov.au/Victoria Planning Provisions/ordinance</a>

Term	Explanation
<b>Terms used in Appendix 2: Species Specific Guidance for Onshore Wind Energy Facilities – Victorian Brolga</b>	
<b>Birdata</b>	An online database that consolidates bird species records that is maintained by Birdlife Australia. The records are sourced from a range of government and non-government contributors. <a href="https://birdata.birdlife.org.au/">https://birdata.birdlife.org.au/</a>
<b>Breeding habitat</b>	The wetland and non-wetland habitat used by Brolgas during the breeding season for the rearing of chicks to fledging.
<b>Breeding season</b>	July to November.
<b>Brolga Breeding Wetland</b>	The nest of a Brolga breeding pair and the perimeter of the surrounding wetland. A breeding wetland also includes wetlands with previous verified records of Brolga breeding nests from the Victorian Biodiversity Atlas (VBA) and Birdlife in the last 20 years. See Section 3.3 of the Brolga guidance in Appendix 2.
<b>Breeding Wetland Buffer</b>	A buffer applied to a Brolga Breeding Wetland in accordance with Section 4.2 of the Brolga guidance in Appendix 2.
<b>Brolga migration</b>	Brolga movements between breeding sites and flocking areas.
<b>Fledging</b>	The age at which a bird can fly.
<b>Flocking areas</b>	A permanent or ephemeral freshwater or saline wetland (including dams, swamps etc) at which Brolgas have been observed to roost (nocturnally or diurnally). Also known as flock roost sites.
<b>Flocking season</b>	December to June.
<b>Modelled wetlands</b>	Wetlands mapped in the Brolga Breeding Habitat Suitability Model.
<b>Potential Breeding Wetland</b>	A wetland that meets the criteria in Section 3.3 the Brolga guidance in Appendix 2.
<b>Potential Breeding Wetlands Buffer</b>	A buffer applied to a Potential Breeding Wetland in accordance with Section 4.2 of the Brolga guidance in Appendix 2.
<b>Victorian Biodiversity Atlas (VBA)</b>	An online database that consolidates species records, maintained by DEECA. Vetted records are sourced from a range of government and non-government contributors. <a href="https://vba.biodiversity.vic.gov.au/">https://vba.biodiversity.vic.gov.au/</a>
<b>Wetland boundary</b>	The boundary from which a buffer must be applied. As a default, the extent of a wetland is based on wetland boundary mapped in the Brolga Breeding Habitat Suitability Model. Boundaries can be realigned.

Term	Explanation
<b>Terms used in Appendix 3: Species Specific Guidance for Onshore Wind Energy Facilities – Bat Species of Concern</b>	
<b>Camp</b>	A location where Grey-headed Flying-foxes rest and breed.
<b>Echolocating insectivorous bats</b>	Bats that use sound waves to determine the location of their insect prey and for navigation purposes.
<b>Key roosting site</b>	<p>A roosting site of particular significance for a Bent-wing species. A key roosting site must meet the following criteria:</p> <ul style="list-style-type: none"> <li>• For Southern Bent-wing Bats, key roosting sites are defined as maternity roosts and non-breeding roosts that regularly contain high hundreds or thousands of bats as verified by DEECA.</li> <li>• For Eastern Bent-wing Bats, key roosting sites are defined as maternity roosts and non-breeding roosts that regularly contain hundreds or thousands of bats as verified by DEECA.</li> </ul>
<b>Maternity cave</b>	A specific type of cave providing a warm and humid environment and used by cave-dwelling bats for giving birth, nursing, and rearing their young.







